CANADIAN MACHINERY AND MANUFACTURING NEWS

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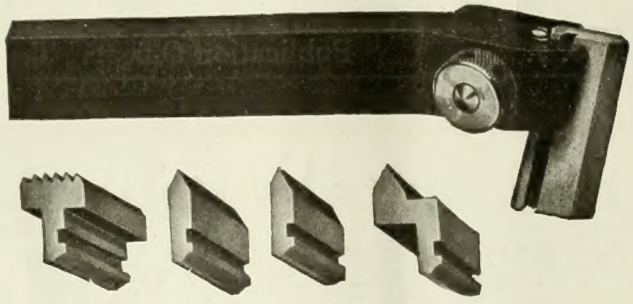

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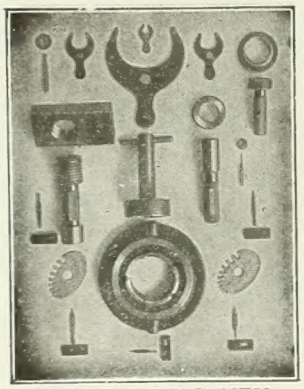

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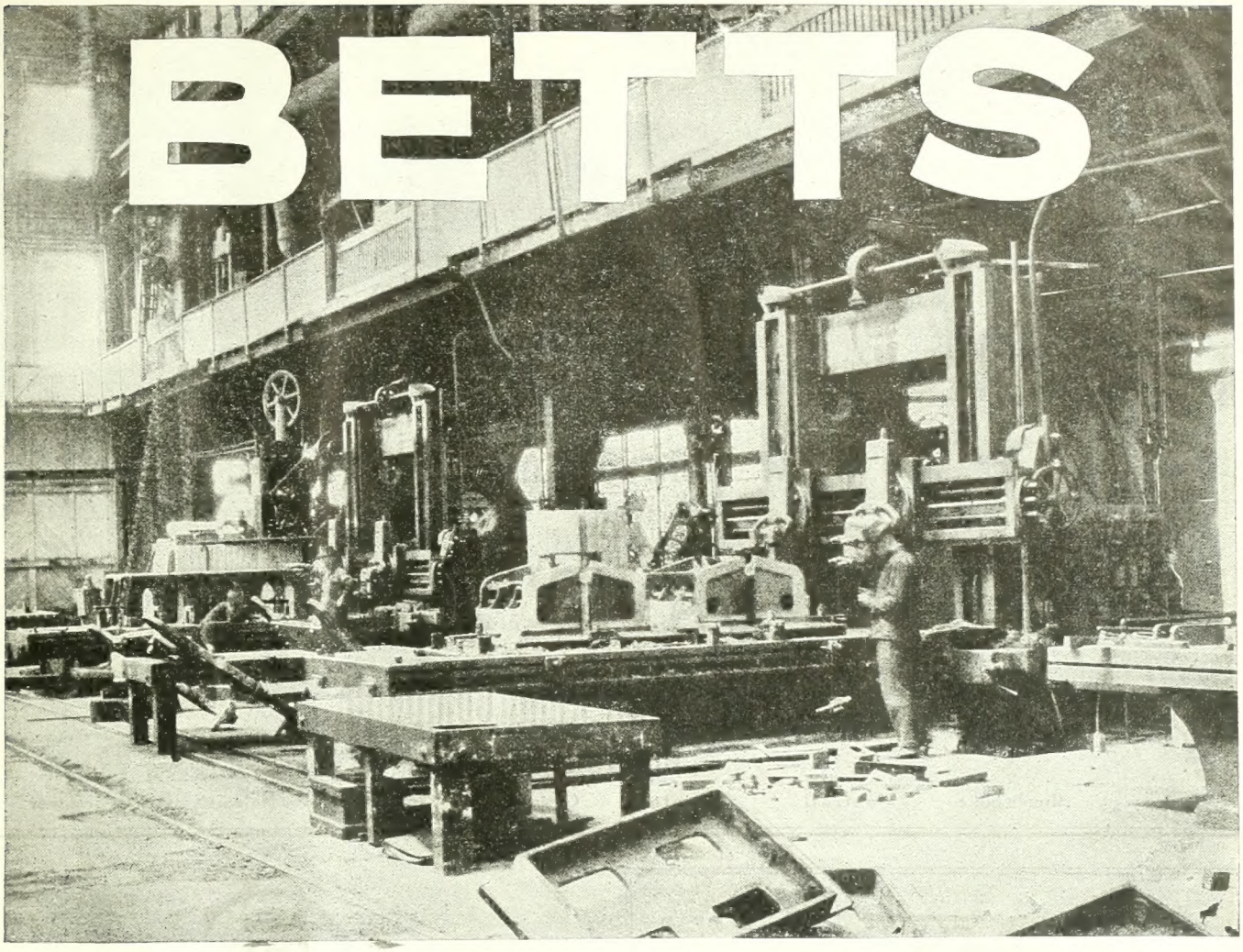

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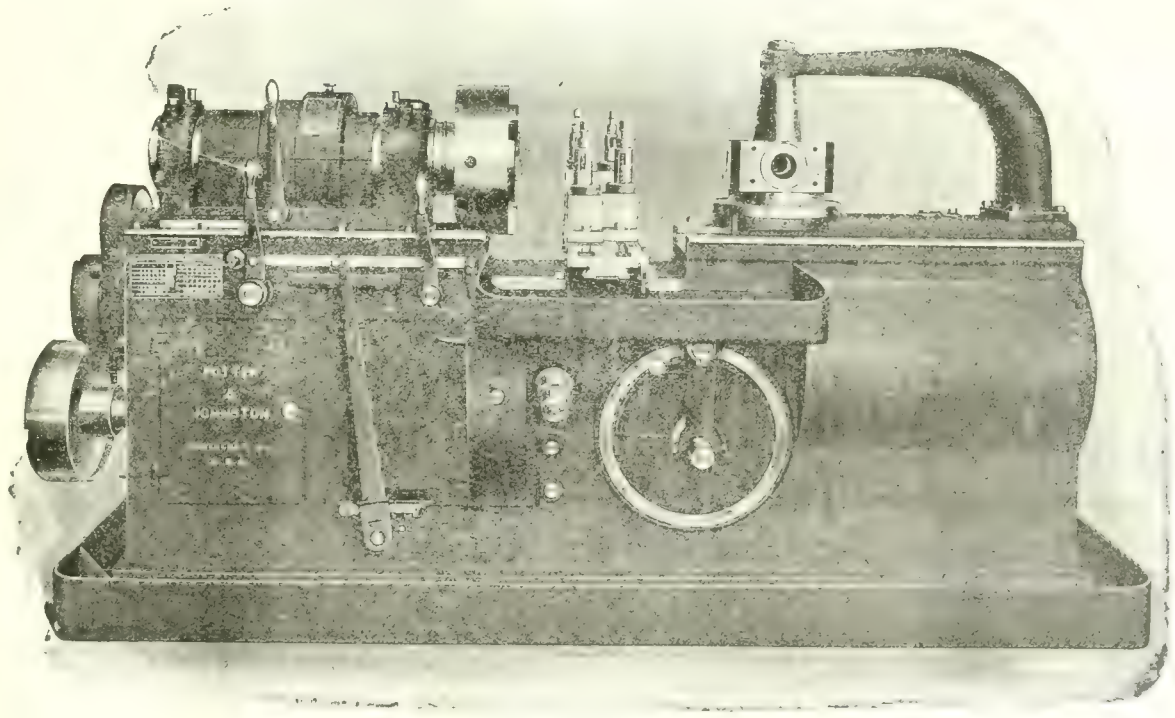

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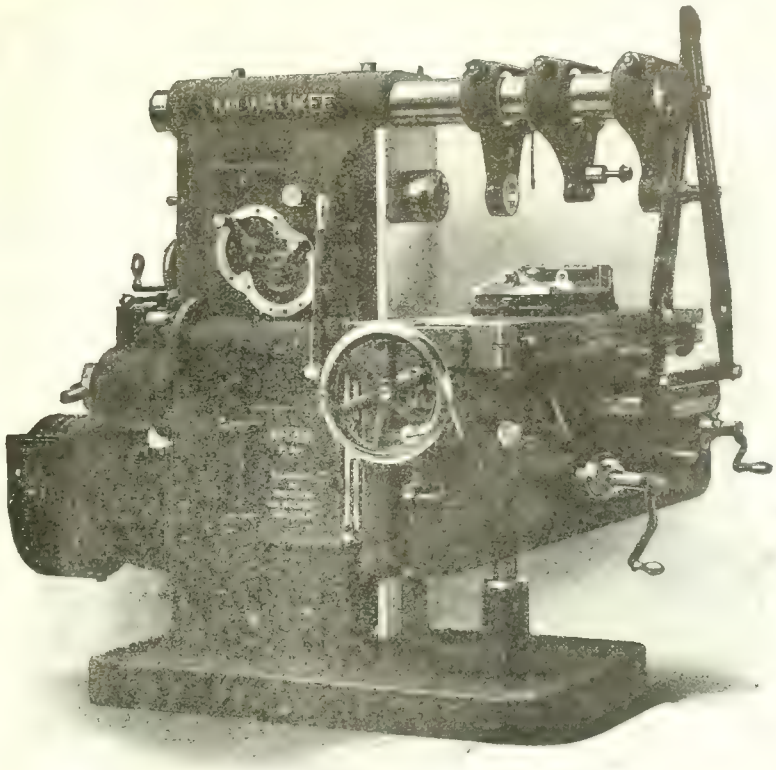

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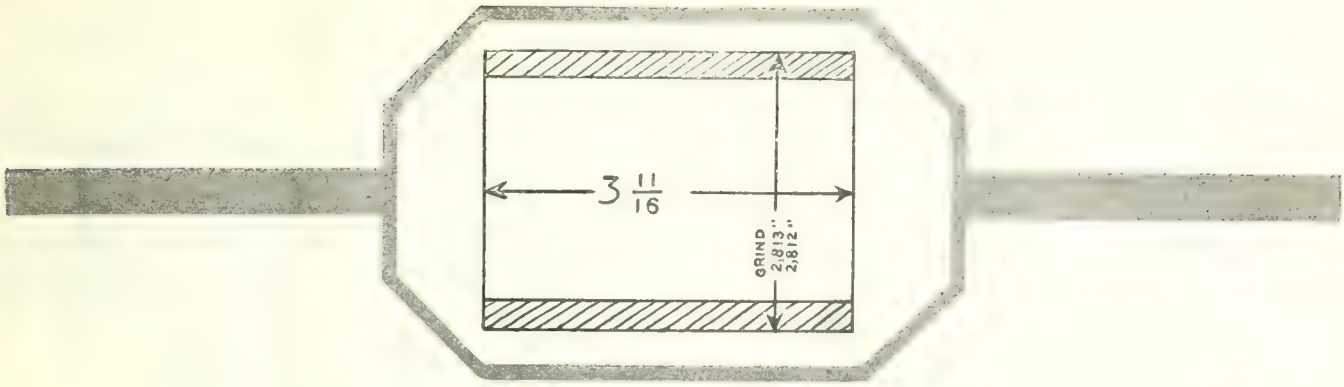

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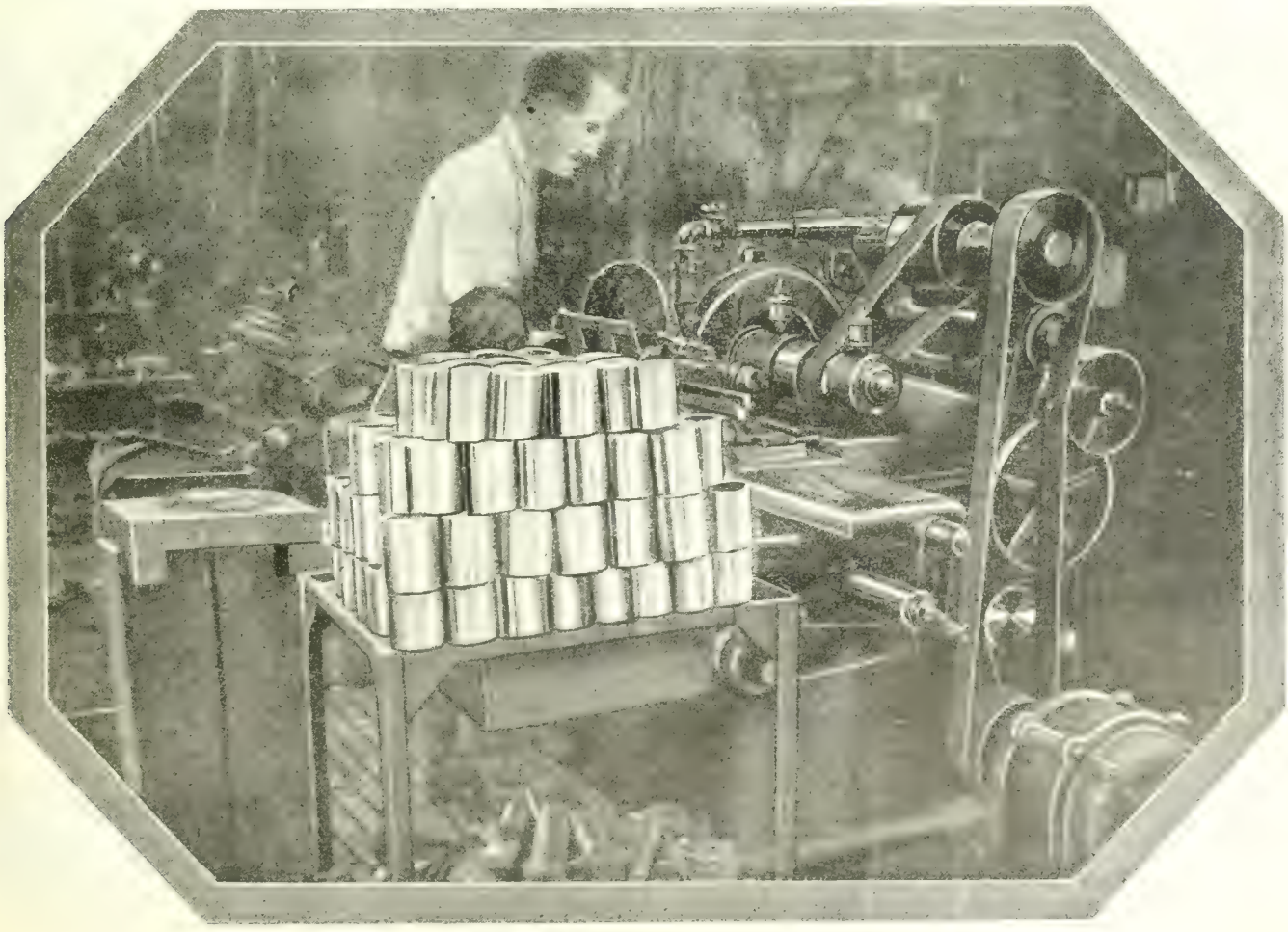

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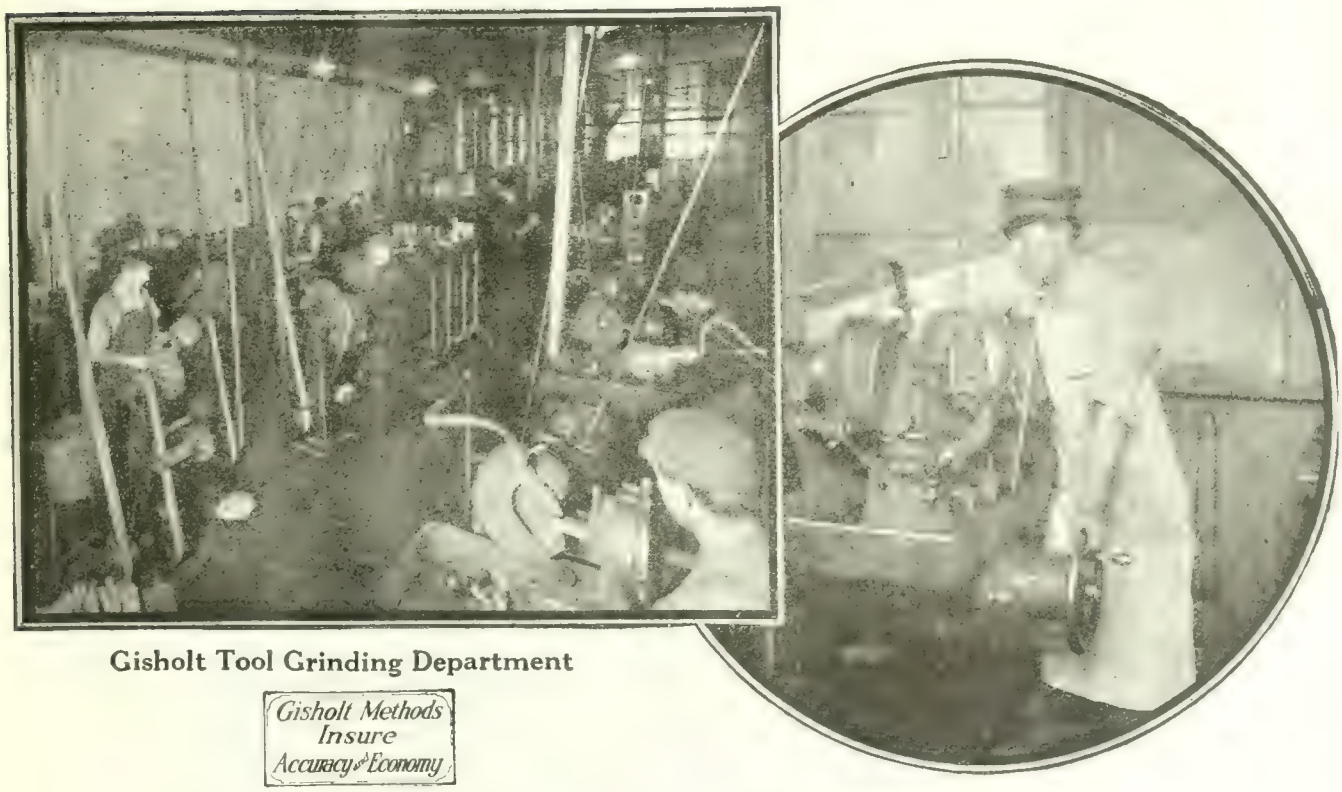

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CANADIAN MACHINERY
AND
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A Railroad Service for the Automobile

Can We Successfully Use the Automobile in Place of the Steam Engine for Railroad Purposes? Read How This System is Being Operated With Splendid Success

By D. A. HAMPSON

WHEN the automobile entered its heyday of popularity it was freely predicted that it would soon usurp the place of the steam train for passenger service. The idea seemed to be that we would have motive power units of the automobile type, larger and much more powerful, and possibly drawing a number of cars behind it as does the locomotive. "But somehow or other, the scheme never got very far," to quote the summary of the average person who had expected such a change in transportation. There were, and are, a number of conditions adverse to the broad application of the gasoline engine to railroad work, the chief of which were the limited efficient speed range of the engine itself, the absence of a satisfactory means of building up a train speed from a dead stop, and the high cost of operation and maintenance.

However, a change has come about in the last five years. The motor truck, from an experimental machine, has grown to be the husky workhorse of commerce that we know to-day. Both in first cost and upkeep it is cheaper now than then; and designs have been evolved that adapt it to every kind of hard service. On the railroads, however, materials and supplies and labor have doubled in price, so the cost of running trains has far outreached the meagre increase in rates. Street railways and branch lines and short independent roads are fighting with their backs to the wall to make ends meet. As the natural sequence of such changed conditions the automobile has been again tried out on railroads and has proven to be quite satisfactory.

Everyone has seen the loads and overloads which are carried by motor busses on our streets and highways, in times of strikes and breakdowns and in the feverish struggle at the height of munitions manufacture, the loads that these machines carried were almost past belief. All such conveyances are bus bodies mounted upon regular truck chasses. It is reasonable to assume that they would perform creditably upon steel rails with their rated loads, a fact proven beyond a shadow of a doubt.

Fig. 1 shows a railroad job that has been running on a steam road for months. The body is a standard 20-passenger bus set upon a Reo chassis. A body of this seating capacity is four feet longer than the car frame, producing quite an overhang at the rear; in this case, the frame was lengthened to

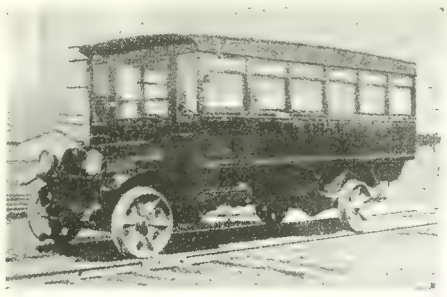


FIG. 1 A GOOD VIEW OF THE CAR.

reduce the overhang and to relieve the rear axle construction.

Raliroad Service

Two of these motor cars are in service on a fifteen mile standard gauge road. Five round trips a day are made with one car, the other one being kept constantly in reserve or to run as second section for a peak load. Slightly over ten gallons of gasoline furnishes fuel for the day's run, with a pint of engine oil, besides the usual "oiling around" for running gear parts. Formerly a steam mixed train made three round trips a day, but this now makes two trips only, the motor train making the third and four other trips, thus providing the territory served with unusually good accommodation.

In common with many other short roads, the cost of operation is out of all proportion to the revenue even with the bunching of the traffic in a few trains. Two engine men, two brakemen, and a conductod constitute the crew in most cases, and these men have good reason to object to a time card that keeps them on the road from early morning until late at night, seven days a week. An extra train crew is a luxury not to be thought of for a minute, so it happens that the small road schedule usually narrows down to a 7 to 6 basis, to which the travelling public strenuously objects with an incessant "disgracefully poor service on this old P. & Q. road."

The motor train has come as a welcome relief to the conditions named. It has ample capacity for carrying the few passengers travelling at most hours of the day. The driver is the entire crew—he may be a serious-minded youth or a middle-aged man, or again the position may be acceptably filled by a disabled soldier. The saving thus effected over the expense of skilled men's wages is a big item. The saving in operation of a car weighing, loaded, two to four tons, as against a train of a hundred tons may be imagined, as also may that of stopping the two to take on or discharge the one lonely passenger so frequently witnessed. With the motor train, therefore, it is possible to give better train service, to extend that service to evening hours and give patrons a chance to attend gatherings that would be out of the question with the steam service. We find then that the automobile on the railroad has enabled us to do two things, i.e., give more frequent service and cut down the operating expenses. With the revenue practically fixed the showing made from the change is gratifying.

One railroad manager hit upon the scheme which is depicted by Fig. 2, a sort of a double ender, which probably has no parallel except on the mountain railroads of Central and South America, where locomotives are built to face and run either way to the front. Our illustration shows two Reo busses coupled

back to back, the total seating capacity is forty, with a possible crowding capacity of nearly double that. The beauty of this arrangement is that no time is lost at terminals in turning around, in fact, no provision for turning need be made.

Going south, engine No. 1 pulls the train, while going north, engine No. 2 works and No. 1 rests with the gears set in neutral. Stated another way, a trailer is pulled on every trip. There is ample power for the trailer at all times: its weight with twenty people is approximately 6,000 lbs., a weight that necessitates but a small draw bar pull mounted, as it is on anti-friction bearings and running over the smooth, comparatively level railroad line. There are, of course, but two driving wheels at any time, and so on a greasy rail the same slipping occurs that is true of steam equipment, but the addition of sand boxes has rid the management of this trouble.

This two car train makes a speed of forty miles an hour at points between

THIS ONE WORKS BOTH WAYS.

stations. It is very popular with patrons of the road, who prefer to ride on it to riding on the mixed trains, because it is cleaner and does not stop to switch cars at stations. Where the road was once a thing of derision, the patrons now take considerable pride in it and its up-to-date equipment and frequent service.

Still another application of the automobile to railroad use is shown at Fig. 3, which shows a Reo with 15 passenger body running on a trolley road. Electric roads have suffered more than steam roads from rising costs, while the nickel remained the chief units of fares and the jitneys robbed them of more or less of their trade. Small roads find the cost of maintaining power plants a heavy burden—much greater in proportion to the power required than with the larger electric systems. It is not contended that gasoline cars are cheaper to operate than electric ones of the same weight and carrying the same two-man crew—they are not. Neither is the wear and tear of frequent starts and stops in city service less for the gasoline vehicle, on the contrary it is a well-known fact that the automobile engine and mechanism is more uneconomical in operating cost when frequent stops are made.

But it is true that the automobile engine operates at its greatest efficiency on long runs, within a limited engine speed range where the thermal efficiency is greatest. And then the cost of a motor truck is small when compared with a trolley car, also the ratio of the load carried to the deadload is far in favor of the gasoline machine. The big does not enter into the railroad automobile operation is that of tires and this does not enter into the railroad automobile at all, for the tires used are good for the life of the car, in fact the railroad wheels can be put on a new car at practically no expense by turning in the rubber tired wheels or tires alone in an exchange. Automobile weights have been pruned by the use of high class materials until the weight per horse power is but a fraction of that in use on all kinds of existing railroads.

A typical case of trolley work is the system of the average city of about 25,000 inhabitants, It has ten or twelve miles of street railway within its city limits, and usually one or more lines extending to neighboring villages; a good average would be double the trackage outside the city that was in it. The heavier and better cars are almost always run on the interurban lines, cars of 28 or 30 tons weight with four 30 or 40 h.p. motors under them. At present rates, these cars run at a big loss most of the time, the rush hour load from some factory, the holiday and Sunday crowds to a pleasure park, and the Saturday afternoon shopping crowds are the only paying times during the week. The rest of the time the cars are running nearly light but the expenses for current and the two men of the crew are just the same.

Hour after hour during the mornings these cars operate with six to a dozen passengers, and for a thirty ton car! Where power can be purchased cheaper than it can be made, there is a saving on the city lines but the suburban and interurban lines still are a drag. What is more natural than to use a motor outfit on such trackage, cutting off the electric current altogether? The outfit in Fig. 3 is one solution.

One man can operate this car. It carries all the morning and light afternoon loads that the thirty ton electric would run for. It gets away faster than the electric car. The way it can pull has been a revelation to many an old trolley man. What is of interest to the passenger is the smoothness of riding, these cars being entirely free from the bobbing of the single truck car and its disagreeable side lurching. Electric roads have much heavier grades than steam roads, but the motor car has no difficulty with these except where stops have to be made on steep upgrades. The single pair of driving wheels not having or getting sufficient traction under unfavorable conditions it is found necessary to rearrange the stops and to fix points where a start would not have to be made on a bad upgrade. A judicious seating of passengers has helped in other cases, so has sand, and so has a freeing of the rails of the grass and grease which did not bother the trolleys. There is no lack of engine power—there is power to slip the wheels on any start.

"How do you reverse?" is a question that might well be asked. Steam roads always have a Y or a turntable at the terminals. Special turntables have sometimes been used for motor cars. On trolley lines either a turntable or a Y has to be put in. Or the double end scheme previously discussed may be worked. Still another way is shown by the photo. The car is run off the end of the rails and turned as you would turn any automobile. As municipal authorities might object to this (although the wear and tear on the street is no more than with heavily loaded horse drawn vehicles with narrow tires) it is now proposed to pave a thirty-five foot square at the track end and turn around on this, by so doing making a good all weather area for car use without in any way detracting from its function as a highway.

It might be inferred from the foregoing that the automobile for railroad use was a perfect, fool-proof piece of rolling stock. It is not. With decent handling and a little attention to well-known vital necessaries, it will do plenty of work and do it cheaply, quickly and with cleanliness. But if neglected as the farmer did his Ford, by running it without oil or water (and then pronounced it a "lemon") the railway automobile will lay down too. However, this is a mechanical age and all men have more or less latent ability in that line, so it is a simple matter to pick out a faithful, serious-minded person to run such cars and give them service attention.

Where rough tracks are encountered the wheel and axle bearings get some pretty hard pounding and these should have weekly inspections. Overloading is an unpreventable evil on the railroad as in ordinary motor trucking service, and this hastens the renewal time for bearings. The same is true with cars in rail-

way service; but as the bearings are standardized, are comparatively inexpensive, and can often be changed between trips, this item is a minor one. These are the only parts found to suffer from the exacting requirements of railway service—quite negligible alongside of average rolling stock repairs.

All of the work with which the writer has been connected, and the experiments, have been made with the Reo model F, commonly called the "speed wagon." The

TURNING AROUND AT THE END OF THE LINE.

time-tried sturdy motor of these trucks has been found fully equal to the demands made upon it, through hauling several times its rated load and under guaranteed conditions. Without holding any brief for Reos, the writer feels under obligation to add that the performance of these trucks, the unique interchangeable system of manufacture, and the reasonable charges for parts should commend them to all prospective users of light trucks for this class of work.

Sharpening the Coventry Screwing Die*

It is Quite Possible That We Have in This Country Some of These English Die Heads in Operation, so for Readers' Benefit We Publish an Account of Method of Sharpening

THE following notes are written for operators who are new to the use of the Coventry diehead and those who have been unable to get the satisfactory results which are generally obtained.

The older forms of screwing dies could not be sharpened after wear. This is true, at least practically, of the half-die, split nut and solid nut forms. It was extremely difficult even to make them correct when new. The engineers at Alfred Herbert's works in Coventry had to face the fact some years ago that the development of the capstan and turrent lathes, on which they at first wished to concentrate their energies, was impeded by the inferior design and quality of cutting tools generally obtainable on the market. The screwing die was one of the chief deficiencies, and they were practically forced to take up the whole question of design of dies and dieheads.

The British screw manufacturers met the difficulties in their own way, and many years ago produced bolts, screws and nuts in all forms and sizes of excellent accuracy and at wonderfully low prices. Manufacture, in the proper sense of the term, is the continuous production of large quantities of identical things. It allows of highly specialized methods, management, supervision and training of labor and special machinery which are not always applicable to the production of a limited number of pieces in the engineering works.

The diehead required, in order to get the full advantages of the new lathes, was one which (1) could be quickly and accurately fixed in the turret, (2) in which the dies were as free cutting as any other lathe tool, (3) in which the dies could be sharpened quickly and accurately to the best new condition, (4) in which the dies would stand prolonged cutting work and many re-sharpenings, (5) in which the dies were positively and reliably self-opening at a set point, and (6) in which the parts were interchangeable.

These results were obtained after a great deal of work and expense, and now there is hardly any tool more accurately made and more widely used than the Coventry diehead.

Sharpening the dies is not a difficult job. Ten of thousands find it no trouble, but there are always a few who require some explanation. These few have not, perhaps, had the opportunity or do not take the trouble to master the mechanical principles involved. The sharpening is not only easy, but an almost automatic process if the right methods and appliances are used. If other methods are used it is an almost impossible job. A highly skilled man who thoroughly understood the forms of cutting tools would not think of wasting hand work time on what he would at once see to be a job for jigs and machine grinding.

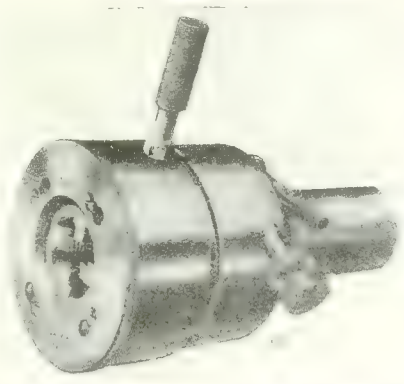


FIG. 1. GENERAL VIEW OF THE DIEHEAD

The method is stated in a very few lines of print in standard form instructions. But we find by experience that while the terse straight style is enough for the skilled or experienced, some explanation is necessary for others.

A general photographic view of the diehead is shown in Fig. 1. The handles for changing from roughing to finishing cuts (where two are necessary), adjusting the finished size and closing the dies, are familiar to users. The dies are plainly seen in this figure in cutting position. A general photographic view of a die, removed from the head, is shown in Fig. 2, and will be useful in understanding the line drawings in the following figures. All four dies, for any size, are alike except on the thread face, where they differ so as to form four stages in the continuous coils of a screw thread.

The analysis of the form of the die can only be followed by separate views of the several surfaces, such as are roughly drawn in Figs. 3, 4 and 5. At this point, however, we may indicate where the mistakes begin when they occur at all.

A man takes out the four dies, as in Fig. 2, and finds one or some of them worn on the cutting edge. He sharpens those that are blunt, and says to himself, "It is no use sharpening things that are not blunt; that would be foolish and a waste of time." That seems to be good logic, but it overlooks the main principle, viz., that the dies are not four independent cutting tools, but one compound cutting tool in four parts. All four, when in action form one tool with four edges in strict relation to each operation, which is not always necesequally until the bluntest one is sharp; because they must not only be all sharp but all the same size in order to divide the cutting work equally amongst them. They must be equal in size as well as equally sharp.

Another kind of mistake follows. A man takes out the four dies and sharpens them equally and properly. On putting them back he finds that they cut like new. He repeats this several times, with equal care, but finds they gradually depreciate in cutting efficiency. This arises from neglect of a second grinding operation, which is not always necessary, but becomes necessary in proportion as the repetition of the first grinding operation wears away the die and alters its shape. This will be explained in the following:

Fig. 3 shows a direct side view of the die, only face H need be ground. The rectangular, as shown by the outside line. Line F—G will coincide with the centre line of the piece to be screwed and of the lathe. The line K—L shows

*From "Machine Tool Review."

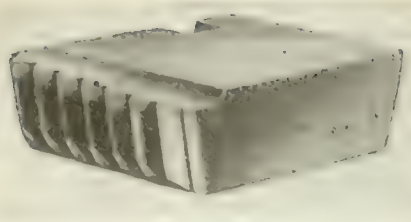


FIG. 1. GENERAL VIEW OF A DIE.

the inclination of the thread in relation to the centre or axial line, and does not concern our present purpose. The die is ground in a tapering direction, creating a face H—the vertical direction of this taper being shown in Fig. 4 and the horizontal direction in Fig. 5. When the die gets blunt face H is ground until the cutting edge is restored, therefore face H gets larger in area at every grinding. H is a clearance face and a means of forming an overhanging cutting edge, so that when the die touches the rod the sharp edge will enter the metal and cut out a space which will leave a thread. This cutting edge is created from two sides; the clearance face H and the cutting face J. Fig. 2 shows the cutting face as a recessed part tapering from the top of the dies body at the back to a lower position at the front. Fig. 3 shows the cutting face as a line J which crosses the line F—G at a point indicated by E. E is the middle point in the cutting edge.

A difference will now be noticed in Figs. 2 and 3. In Fig. 3 the clearance face H is of relatively larger area, the first partial thread is more to the back of the die and at the same time the cutting face J is lower in the body of the die. This difference may be considered as the difference between a new

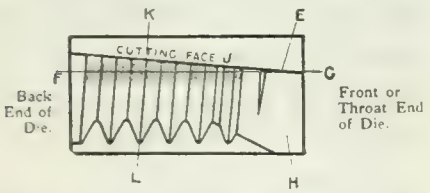


FIG. 2. DIRECT SIDE VIEW OF A DIE.

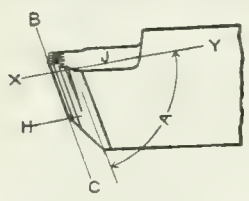


FIG. 4—DIRECT FRONT END VIEW OF A DIE.

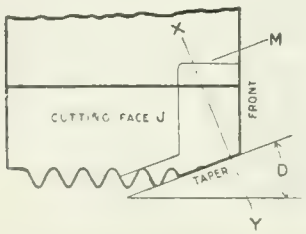


FIG. 5. TOP VIEW OF A DIE.

die (Fig. 2) and a die (Fig. 3) that has been in use for some time and has been ground properly. The difference between a new and a much-used and sharpened die is that the line J (Fig. 3) gets to a lower position in the body and the point E moves to the left.

For the sole purpose of sharpening the die, only face H need be ground. The roundness or bluntness of the edge is removed by taking metal off H only. A necessary consequence of this sharpening, however, is to leave the cutting edge above the line F—G. Then the edge will not cut because it is too high, just as a turning tool will not cut if placed too high in the slide rest. For this reason it becomes necessary to grind down the cutting face J.

The cutting edge extends a little to the right and left of E (Fig. 3). E is the centre of the length of the cutting edge, hence it is possible to sharpen the dies several times without seriously impairing their cutting efficiency. That will be the case especially if the sharpening is done as soon as the least bluntness appears and when very little grinding will be necessary.

It is good practice and economical in all ways, to keep the dies sharp. This is true of all cutting tools. There is an old workshop saying: "Don't sharpen your tools, keep them sharp."

The line B—C indicates the direction of the thread; D the taper of cutting edge or its angle in relation to the line F—G on a horizontal plane, and A the cutting angle. The cutting angle is formed and measured on the two faces H and J; the direction of the H line being shown on Fig. 4 and that of the J line by the line X—Y on Fig. 5.

When the die is very much worn away by repeated grindings its cutting qualities will be maintained. It will last a long time but not for ever. The disadvantage is that as the cutting edge goes back the die would not cut so close to a shoulder. This can be remedied by grinding away the die body as indicated by line M, of course only to the necessary extent.

The back threads, shown at the left of Figs. 3 and 5, do not cut, but act as a guide and smoother on the thread after it is cut. All the cutting is within the limits of the taper line on Fig. 5.

In grinding it is necessary to use the jig specially made. The four dies are ground at once, clamped in the jig in their proper order. If care is taken to use the right jig and to place the dies properly the sharpening is easy and the correct angle is obtained automatically. A special graduated gauge is made for testing the point E to indicate when grinding the face J is necessary and to grind it correctly. All the four dies must be ground on the face J equally. These jigs and gauges are not included with every diehead because one set will serve for a very large number. One set is necessary whether the dieheads in use are many or few.

An English scientist declares that insomnia may be cured by removing excess moisture from the lungs. To put his theory into practice, he has devised a small machine for supplying warm, dry, filtered air, which the patient then breathes through a nose tube secured to the head with tape. The process is said not to be uncomfortable.

Saving controller contacts from damage by arcing is the object of a European inventor. In series with the contacts he connects hot-cathode rectifier tubes, whose heating circuit is broken by the switch arm in advance of the main circuit. The momentary interruption of the current prevents any arc formation.

The number of German airplanes destroyed by the French aviators and the members of the Lafayette escadrille for the ten months ending October, 1917, was one hundred and twenty over the French lines, and three hundred and ninety-seven over the German lines—all total wrecks.

For a long time the waste steam from steam-engines has been turned to good account, but there have been difficulties in the way of using the exhaust gases from a gas-engine as they readily attack the metal of the conduits. However, the difficulty is being overcome, for a New Jersey candy factory has an installation in connection with a sixty horsepower engine which is used to heat the factory. The gases pass through an economizer made of cast-iron, with the passages to the different sections staggered so that all parts are heated for the whole length. Water circulates in jackets surrounding the gas passages.

The hoe-blades are fixed to the lower ends of arms suspended from a crank-shaft. Bars extending from the hoe arms to rocker arms at the rear of the machine regulate the movement of the hoes, imitating the strokes and motions of an ordinary hoe worked by hand. The crank-shaft that drives the hoe-blades is connected by a chain, sprocket-wheels, a gear-shaft and gears with the main or driving axle. The device may also be arranged to be driven by power from a small gasoline engine, but it is not very hard to run by hand.

ERRATA

In our July 31 issue, an page 126, we illustrated an electric storage battery truck, which we mentioned was handled by the Electric Storage Battery Co., of Philadelphia. This was an error, as the truck shown was made by the Baker R. & L. Co., of Cleveland, Ohio, but was equipped with a battery of 24 cells MVY-17 Ironclad-Exide, which are manufactured by the Electric Storage Battery Co., of Philadelphia.

Novel Portable Electrical Drill Heads

Both English and German Type of Portable Electric Drill Head is Herein Described. The Unprecedented Range of These Tools Make Them Exceedingly Valuable in Many Classes of Work

By FRANK C. PERKINS

THE accompanying illustration, Fig. 1, shows the operation of a novel English portable electrical drill head, developed at Bootle, near Liverpool, England, while in drawings Figs. 2 and 3 and photograph Fig. 4 may be noted the construction and use of a unique German portable tool head in cylinder boring; also German tool head with pivoted tool seat and telescope shaft, driven by an electric motor at the works of the Allgemeine Electricitats Gesellschaft at Berlin. It is claimed that this portable electric drilling machine has an unprecedented range, and can be instantly adapted, with the minimum amount of trouble, to work under almost any conceivable conditions. The motor may be operated in any position on the ground, or speedily detached from the carriage and slung up in the air, without the use of stay ropes, steadying gear, or platforms.

It is pointed out that there are no flexible or telescopic shafts, knuckle joints, or similar devices for transmitting the power from the motor to the drill. The drive is practically direct, and the important advantages of this arrangement will be fully appreciated by those who have had experience with the earlier methods. It is a sound mechanical tool with no complicated gearing likely to get out of order, and is of such a solid character that it is almost impossible, with fair wear and tear, for any part to cause trouble.

It is maintained that the whole machine may be easily managed by one man, who can start and stop instantly, without removing his hand from the drill head. The field for the employ of this drill is almost illimitable. Many steamships with electrical equipments carry them, as the engineers have at command an appliance enabling them to carry out with neatness and despatch the repairs usually necessary in the event of a breakdown.

This novel English portable electrical drilling machine consists of an electric motor, sliding shaft, and universal movement drill head. The motor is carried on two horizontal centres, by a frame which may be moved at will, in a complete circle, on the carriage proper of the motor. The carriage itself is furnished with suitable handles and wheels to permit of easy movement from place to place. The motor can be instantly removed from the carriage and suspended in a stirrup or bow provided with the outfit, when required to suit the working conditions. On the top of the motor is a bracket carrying a hollow shaft. This hollow shaft is provided at one end with a spur wheel, which is driven from pinion on armature shaft. Through the hollow shaft slides a long shaft, the extreme end of which is connected with the drill head. The long shaft is slotted for nearly its whole length, and this slot fits a key on the inside of the hollow shaft. Thus the motor drives the hollow shaft by means of the key and slot, and the motion is transmitted to the drill head.

The drill head is constructed with two pairs of bevel wheels (four wheels in all) in such a manner that the drill may be turned through a complete circle in a plane at right angles to the long shaft,

FIG. 1. ENGLISH ELECTRICALLY OPERATED PORTABLE DRILL IN OPERATION

and through an almost complete circle in the same plane as the long shaft. The switch for stopping and starting is fixed direct on the drill head, thus giving instant control to the man who is drilling. The special universal worm-geared drill head, combined with an adjustable stand, can be coupled to the shaft of standard drill when specially required for tapping as well as drilling.

It is stated that this portable electrical drill will drill holes up to 1½ in. diameter in steel. The motor is 1½ brake horse power, which will take approximately 1,300 watts. This is 1.3 B.O.T. units per hour. The cost of electrical power per B.O.T. unit in most towns in England, from corporation supply, averages 3 cents. On this basis the drilling machine will cost 4 cents per hour. Where electrical power is taken from private firm's own plant, as would be generally the case, the cost would be less than this, and would vary according to the efficiency of the plant. The motor weighs 240 lbs. and carriage 138 lbs., while the weight of the shaft is 24 lbs. and the drill head weighs 44 lbs.

It is claimed that this machine has been very largely adopted by many of the foremost engineering firms in the United Kingdom and abroad, being used for a variety of purposes, embracing bridge-building and general constructional iron work, shipbuilding and ship repair work, locomotive and stationary engine building and tramway track work, also for colliery work and general engineering of all descriptions.

It is held by English engineers that this electric drill combines in a greater measure than any other machine of its class, the advantages of a fixed and portable drill. It is an excellent substitute for ratchet and pneumatic drills, the latter, owing to their excessive cost in up-keep, together with the heavy cost in application, are being rapidly superseded by electric drills.

As above stated, it is direct driven and all flexible shafts, knuckle joints and similar contrivances are dispensed with, and the simplicity of operation is thereby increased enormously, whilst loss of power in transmission is reduced to a minimum. It is under instantaneous control, the switch being fixed on the drill head or contiguous thereto, within reach of the operator. One man can easily handle the machine. The universal movement drill head and sliding shaft enable the apparatus to be worked in practically any position.

In the operation of this English outfit, with its carriage, sliding shaft and universal movement drill head, the motor is series wound, this being found preferable to the shunt wound type, the power absorbed being in proportion to the work done. The motor is carried on two horizontal centres by a frame which may be moved in a complete circle, the whole being mounted on a carriage furnished with handles and wheels to permit of easy movement from place to place. If necessary the motor can readily be removed from the carriage and suspended from a stirrup or bow.

On top of the motor is a bracket carrying a hollow shaft fitted at one end with a spur wheel, which is driven from pinion on armature shaft. Through the hollow shaft slides a long shaft, one end of which is connected to the drill

head. The long sliding shaft is slotted for nearly its whole length and this slot fits a key on the inside of the hollow shaft. Thus the motor drives the hol-

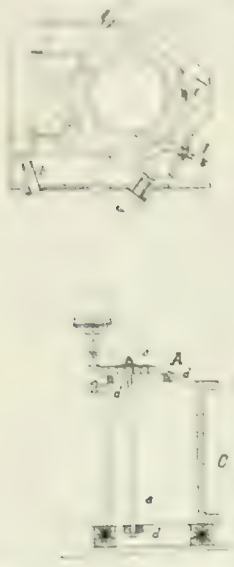


FIG. 3 GERMAN PORTALE TOOL HEAD IN CYLINDER BORING.

low shaft, and by means of the key and slot the motion is transmitted to the drill head. The gearing on the motor and drill head is entirely covered, thus protecting the workman against accident, and all terminals are protected. The machine can be made reversible for tapping. Arrangements are in progress for fitting the drills with a variable speed attachment, where required.

The special hand electric drill is one of lightest and most useful machines in service and it can be coupled up to existing lamp holder or wall plug and controlled by small switch attached to the body of the drill. Its applications are numerous, principally for direct drilling as a breast drill, or for working in a drilling pillar with ratchet feed. It is capable of working at any angle and in practically any position. One of the handles can be removed to enable the machine to be operated in confined places.

Its capacity largely depends on the nature of the work. The motor is capable of drilling holes up to ¾ in. diameter in metal, but under favorable conditions holes up to ⅞ in. diameter can be drilled. Its speed is 1,300 revs. per minute on motor and 150 revs. per minute on drill spindle, and holes ½ in. diameter can be drilled through ½ in. plate in 50 seconds, or ⅞ in. diameter in 80 seconds.

This English drill can be used for drilling, reaming, tube expanding, milling, grinding and tapping, and is specially adapted for drilling in positions where stationary machines cannot be employed. In order to obtain the maximum efficiency of the drill, it is necessary to use high speed tool steel which is self-tempering and continuous cutting when nearly red hot. It therefore requires less grinding, and the rate of drilling is much higher than can be obtained with ordinary tool steel.

AIR SCREEN FOR FURNACE WORKERS

An account was recently given in a German technical paper of the latest methods employed in Germany for screening furnaces. Workers required to examine the glowing material at frequent intervals suffered a great deal from the excessive heat radiated, and various devices have been tried to minimize the ill effects. For example, hollow water-cooled furnace doors have been tried, but obviously they afforded protection only while closed. Again, devices have been installed for drawing off the hot air in front of furnaces by centrifugal exhausters placed in front of the furnace opening. An objection to these is that workers are subjected to great variations in temperature prejudicial to health. According to the article quoted, the most effective device is to fix immediately behind the furnace door a narrow, oblong nozzle, through which cold air is blown upward, thus interposing a screen and relatively cool air between door and furnace. This arrangement is to give adequate protection to the worker, and has the incidental advantage when the doors of the furnace are opened, the escape of flame is checked.—Engineering and Industrial Management, London.

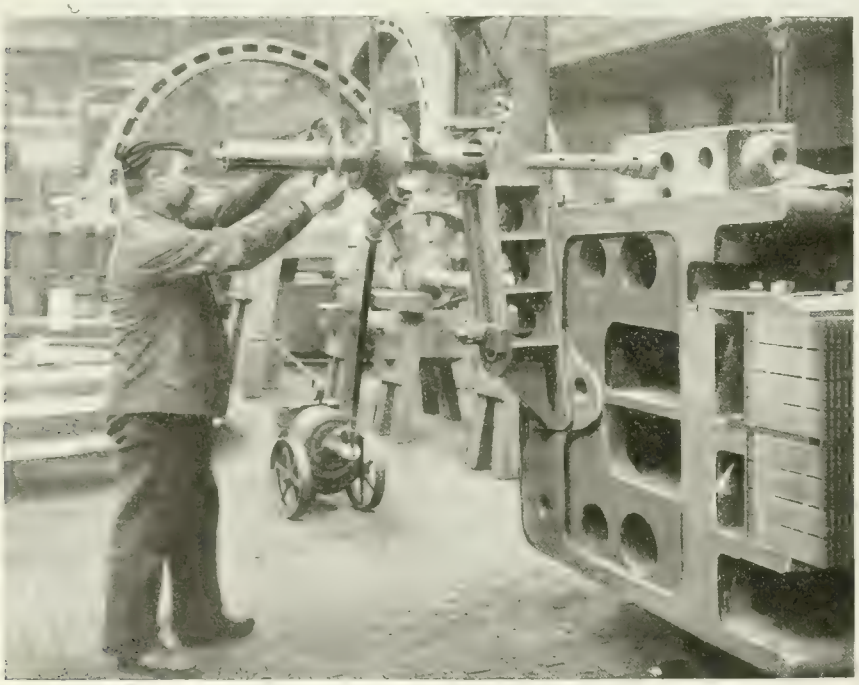


FIG. 4—GERMAN PORTABLE TOOL HEAD, WITH TELESCOPE SHAFT OPERATED BY ELECTRIC MOTOR.

AIR RESISTANCE OF TRAINS

The advance of aeronautics has, among other things, made engineers generally pay more attention to the importance of so shaping objects which have to move at high speed through the air that they shall offer as little resistance as possible. Anyone who puts his head out of the window of an express gets some idea of the pressure of a sixty-mile-an-hour wind, but he may not give a thought to the fact that the same pressure is helping to retard the progress of the train. It has been calculated that the flat front of a locomotive smoke-box offers sufficient resistance to absorb about 32 h.p. at 60 miles an hour, and 75 h.p. at 80 miles an hour. By giving the smoke box a hemispherical front the figures could be reduced to 7 h.p. and 15 h.p. respectively—a very important decrease. By reducing the width of the buffer beam, avoiding pockets in the sides of the engine, giving the tender sides and a roof of the same height of the carriages, decreasing the gaps between carriages, stream-lining accumulators and air reservoirs and making windows as nearly flush as possible, train resistsance would be greatly lessened. A tapering tail, such as is fitted to a racing car, would have good results, since the suction at the rear of a train is very considerable, but there are practical objections to its use. Experiments made in America showed that a flat-ended electrically propelled carriage could not be driven at 50 miles an hour by power which sufficed to give a similar carriage with parabolic front a speed of over 75 miles an hour. This seems to show that there is plenty of scope for reducing the power bill of our railways by applying to trains some of the care which is expended on designing the lines of a fast steamship.

One of the most efficient lock nuts for small bolts is a piece of sole leather or belt leather. Bore a hole in a small scrap of the leather, and screw it on the bolt just outside the iron nut. If the leather nut is a tight fit, the iron one will never rattle off.

The Various Mechanical Properties of Steel

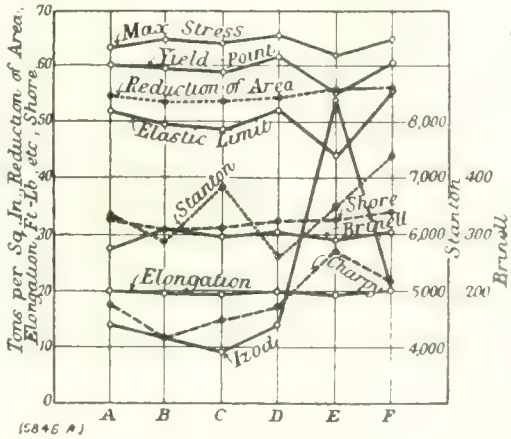
Taking Up the Consideration of the Question of Brittleness, Together With Investigation of Failures of Various Kinds. A Paper of This Nature on Steel is Especially Valuable at the Present Time

By W. H. HATFIELD, D. Met. of the Brown-Firth Research Laboratory, Sheffield, Associate Member

ULTIMATE success in ensuring the safety of parts constructed of steel is dependent upon a sympathetic collaboration of the engineer and the metallurgist. A perusal of recent publications leaves the definite impression in one's mind that at the present moment engineering design has hardly attained the position in which it can be considered as a subject for purely mathematical treatment. We have much to learn, not only concerning the distribution of stress in the different parts under working conditions, but also of the actual mechanical and physical properties of the steels when in the diverse conditions under which those various parts are called upon to perform their duties. The author hopes in this paper to extend somewhat the data at present available in this direction. In a recent paper, Dr. Rosenhain, F.R.S., and Mr. Hanson* made the following statement: "For this purpose an impact test has been used, for, although it is recognized that conditions under which failure occurs in boiler plate possess no apparent resemblance to those of an impact test, yet experience has shown that materials which give a low figure under an impact test are liable to fail under apparently static conditions." It will be seen that the authors quoted seek to determine the safety of a part under static conditions by the employment of a dynamic test.

One can, however, appreciate the question at issue in their minds, and it is hoped that this paper may throw a little light on such matters. Another recent statement, in this instance, by Dr. Arnold, F.R.S.** has a bearing upon the subject under consideration. He states: "In fact, no matter how dangerously brittle steel may be from chemical or physical causes, if such causes have coproduced a high elastic limit, the Wöhler test indicates the steel to be quite safe if stressed well short of that limit, when, as a matter of fact, it is inevitable that the steel must certainly rupture soon or later under stress theoretically quite safe." The author's reply to Dr. Arnold would be that any theoretical conclusions of the type to which he is referring must be based upon insufficient data. If a part is not stressed beyond its elastic range it must necessarily successfully withstand the stresses upon which it has to deal. It is considered that Professor Unwin, F.R.S., adequately deals§ with the subject in the following words: "All the published experiments on endurance tests have now been brought together and reduced to common measure, because the subject of safe limits of stress, especially in bridges, must, before long, be reconsidered, and because, while experiments of this kind take a long time to make, it is the number and the consistency of the results which are most impressive. A few results of bars breaking with comparatively small stress may be put aside as possibly accidental or abnormal, but here are four completely independent series of researches by different observers

Fig. 5. TESTS ON SIX STEELS 60 TO 65 TONS



ILLUSTRATIVE CHART.

(Wöhler, Sir Benjamin Baker, Bauschinger and Spangenberg) with stresses of different kinds on very different materials, and the whole of the results are singularly consistent. In all cases the number of repetitions of loading the bar will bear diminishes with increased range of variation of stress."

One might continue with advantage, to quote Professor Unwin's summing up of the data extant at the time at which he wrote, but those interested may refer to the original at their leisure. The author has always considered Professor Unwin's reply as an adequate commentary on such statements as those already quoted.

It is clear that there is a safety range of stress in which any given material may be stressed for an indefinite period. There is obviously a minimum range of stress which, over a long period, will produce rupture. However long this latter period may be, it is clear that whilst on more or less empirical calculations the stresses may have been shown not to exceed the elastic limit of the part under consideration, it is certain that some local piling up of stress must have taken place to produce rupture. If we now supplement the work to which Professor Unwin has referred with items from recent investigations, it is possible to obtain a more complete picture of what is happening. The work of Dr. Coker and others upon unequal stress distribution during recent years has done much to indicate the insufficiency of some of the empirical calculations upon which design has depended so much in the past.

The researches of Rosenhain and Ewing, and others, with regard to the development of slip-bands and the commencement of failure of crystalline metals, have done much to explain the effect of local accumulation of stress. It will be seen from these remarks that it is considered that, given reliable material, it should be possible, in the course of time, when our data are more complete, to so determine our factors of strength that the different parts of our various mechanisms may be perfectly reliable.

The engineer is familiar with the properties of steel, in the first place by actual experience with it in service, and in the second place by the results obtained from different mechanical tests to which such materials are put. The mechanical tests at present available may be recapitulated somewhat as follows. The static tests include tensile, torsion, bend, and Brinell. The dynamic tests include the Izod, Charpy and Fremont impact tests; the Stanton repeated-blow test, the Sankey, Arnold and Wöhler alternating-stress tests; the Shore scleroscope should also be included in this category. There are also the different wear tests, such as those devised by Dr. Stanton, Mr. Saniter, and others. There are other tests, but those just mentioned represent the ones which the author employs in his (different) investigatory work.

Later in this paper will be found instances of results obtained by the use of them, and in Appendix I will be found the size of test-bars employed, together with a statement of the detailed conditions, so that direct comparison may be made with similar tests performed by other investigators. The author would at this stage take the opportunity of emphasizing to engineers the danger of crediting any particular types of test with predominating importance. In his opinion, the tensile test is fundamental, but all the other tests are valuable as bringing out in each case data not other-

*Paper read before the Institution of Mechanical Engineers, on Friday, May 2, 1919.

**Journal of the Iron and Steel Institute, Vol. I., 1918.

†Inst. of Naval Architects, 1908.

§"The Testing of Materials of Construction," page 355, 1899 Ed.

wise fully disclosed concerning the properties of the steel under examination.

The Investigation of Failures

As regards failures in service, the author's experience is that there is frequently some obvious cause. Whether or not the cause is obvious, it is, of course, existent. The fugitive nature of the explanations of some failures which he and others have experienced is the real reason for the presentation of this paper. Whilst discussing failures in service, it is well to point out that the explanation of failure is frequently assisted by examinations of examples which have done excellent service. Too little examination is made of the latter, and it is frequently the case that many features of failures are considered to be bad ones, which would most likely be cancelled out by the same features being discovered in excellent examples. When cases come to the Brown-Firth Research Laboratories for investigation, the following procedure is adopted. In the first place, the design of the part and its relation to other parts in the mechanism in which it serves, are carefully studied, together with the actual conditions of service, that is, the magnitude and manner of the stresses the part is called upon to withstand. In this preliminary investigation some idea is obtained as to the possible mechanical causes of failure. The manner in which said failures would be assisted by inherent undesirable characteristics in the steel is next investigated. The chemical composition is determined to indicate the quality of the steel; the microstructure is examined to determine the thermal treatment to which it has been submitted, and the microstructure is developed with a view to determining the homogeneity of the mass. The mechanical tests, including an adequate selection of the previously enumerated ones, are performed. For purposes of comparison a companion examination of a successful part is put through wherever possible.

As a result of numerous investigations, failures seem to place themselves in different categories. Treating the matter broadly, there are two types. In the first one, failures would be included where the material has rightly been assumed by the engineer to possess strength and freedom from defects, but when the material unfortunately did not merit his confidence, that is, the material has failed to live up to reasonable expectations. In the second category, would be placed the wide range of cases where subsequent examination has shown the material reasonably to possess properties which the engineer associated with it, but where failure has obviously been due to insufficient knowledge or to too empirical treatment on the part of the engineer with regard to the stresses with which he had to deal.

In the first category one would include cases where the steel is put to work in the wrong condition: where it has received faulty heat-treatment; where it has been put to work in an unstable condition: and lastly, where the part has been placed into service containing undiscovered actual defects. In the second category one must include bad design; imperfections of the technique and production; abnormal stressing (shock, deformation leading to overstressing, etc.); an imperfect knowledge of the full properties of the steel by the engineer; and lastly, an imperfect knowledge of the distribution of stress in the parts under consideration.

Fatigue failures, so called, may come under either category, that is, the steel may be well below the requirements in strength, or the part may be too weakly designed to withstand the repetition of stresses which has to be encountered. There are two further sources of failure which it is considered should also come under the second category, namely, wear and corrosion. The author recently investigated a very serious case where the failure of a shaft through corrosion would have been prevented had the engineers responsible appreciated the more simple causes of corrosion. The question

FIG. 1—A FRACTURE.

of wear is naturally a matter definitely within the field of the engineer, although the metallurgist must take some responsibility.

Different cases of past failure which have been thoroughly investigated are of considerable interest. At times also such cases are aggravating, since, as years pass along, new methods of approach and means of testing are developed, from which, could they only be applied to some of the past cases, clear explanations might possibly be provided of important cases which are even now only improperly understood. Whenever possible some of the material of such important failures should be retained so that in years to come some of it can be forthcoming to form the subject of subsidiary helpful investigations in the light of more recent knowledge. It is stated that the Greeks raised an altar "to the unknown God"; it is our practice always to retain a suitable piece of steel for submission to that new and at present unknown test, which it is hoped will some day be devised, capable of giving information which at present is absent from our tests. A few of the types of failure at present under discussion may be quoted.

Some little while ago the author read with considerable interest a paper by Mr. Sidney Houghton* on "Certain Failures of Steel Boiler Plates under Pressure." Mr. Houghton surveys and discusses a number of cases of failure, and apparently comes to the conclusion that we are yet without a satisfactory explanation of some of the most serious causes of failure in that field. The author has carefully followed many of the cases to which Mr. Houghton refers, and he is entirely of the same opinion. In the discussion of this paper Dr. Stead, F.R.S., described a very interesting case of a boiler-plate burst under pressure. It was found that there were many hundreds of fine hair lines running from the rivet holes, yet curiously there were many good features about the plate. The analysis would be considered satisfactory, but the carbon was as low as 0.09 per cent. The maximum stress was 24 tons, the elongation 30.7 per cent., whilst the reduction of area was 64 per cent. Dr. Stead stated that, in his opinion, the yield was probably about 12 tons. It is recorded that the microstructure was good, and that the non-metallic inclusions were not pronounced. One very interesting feature of Dr. Stead's investigation was the alternating-bend test to which he submitted some of this material. A value of 733 reversals before fracture was obtained, which was quite good when compared with the value he states for good English plates, namely, 760 to 970. This alternating-bend test, coupled with other considerations, would certainly point to the material being by no means in a brittle condition. Dr. Stead was not dogmatic in his conclusion as to the cause of failure in this instance, but was inclined to think that the cracks were produced by the maltreatment of the material in the vicinity of the rivet holes. It is of interest to record that he thinks that the low yield may probably have assisted failure by fatigue. This is a well authenticated case of failure carefully investigated by a recognized authority, and is certainly most instructive. It is hoped to refer to it later. The actual manner of the distribution of the stresses in the vicinity of the rivet holes is of considerable importance, and has been tackled by several investigators, notably Dr. Wolff. The design and technique of the riveting will always have a profound influence, and no doubt many of the failures in boiler plates might be rightly traced in that direction.

(To be continued)

Assuming that 10 per cent. of the total power represented by the Victoria Falls, Rhodesia, can be usefully developed, the water powers of that country are capable of generating about 220,000 electrical horse-power. Of this amount some 95,000 horse-power would come from the Victoria Falls and the following rapids at Kariba Gorge and Mapata, while the Sabi River system would supply about 91,000 horse-power.

Worth-While Information From Many Points

A bolt that has been lost may be replaced by a wood screw and a leather nut. This idea is especially useful on small-sized vehicles, ton wagons, baby cabs, and the like.

* * *

An American still holds the world's airplane altitude record with 28,900 ft., as recent rereading of the British claimant's instruments showed a revised height of only 27,000 feet.

* * *

A hoeing machine, invented by Otto F. Ullman of Severy, Kansas, operates several hoe-blades simultaneously. It does the work of three or four men armed with hand-hoes. Only one man operates the machine.

* * *

When a piece is held in position on an arbor by means of a nut and washer, it is usually necessary, in order to remove the piece, to take the nut entirely off. Where a number of pieces are to be handled, this requires considerable time. To avoid this time-wasting method a slotted collar may be used, making the nut and washer of such a size that the piece may be slipped over them without removing them from the stud.

* * *

Magnetized screwdrivers are useful for many classes of work, the carbon steel of which screwdrivers are made being capable of retaining considerable magnetism. A screwdriver which will retain a considerably stronger magnetism than an ordinary one, may be made from a round piece of tool steel, or preferably of tungsten steel, by simply grinding the end of a bar into the form of a very short screwdriver blade.

* * *

The use of a cold chisel by anyone inexperienced with it usually results in the hammer occasionally striking the hand instead of the chisel, with disastrous results. For the use of beginners, and possibly some of the older workmen who occasionally fail to hit the chisel directly on the head, it will be helpful to cut out a disk of old leather belting, making a hole of the proper size in the centre, and mount it on the end of the chisel to break the force of any misdirected blow.

* * *

Two large shipwrecking firms in England have been commissioned by the British Government to receive and distribute certain of the waste war materials imported from the Western fighting front. Scrap iron of low grade is melted into bars for the tin-plate industry. Steel bars of better quality are rolled into plates that are used in constructing trench shelters. Approximately 80 per cent. of the tin, terne, and black-plate mills of the kingdom are situated within 20 miles of the port at which the scrap is received from the continent.

* * *

"Flivver" airplanes that will carry two passengers and have a wing spread sufficiently narrow to make possible a landing on a country road are to be manufactured at the Maryland Pressed Steel Co.'s plant at Hagerstown, Md., according to reports. The first plane of this type was witnessed by the July 4th gathering at Towson and is the invention of an Italian. It was the idea of the War Department to use the planes in France, but after the signing of the armistice the inventor was induced to work on a peace plane.

* * *

A jackshaft or conveyor, if driven by a belt, may give a warning of its own stoppage by the use of an electric-bell wire with push button, and over it a piece of slat, held up by a spring. Place these so that if the belt comes off, part of its weight comes onto the slat, thus depressing the push button and closing the circuit. This may be used with either horizontal, vertical, or inclined belts, provided the surroundings permit the installation of wires and push-button support at suitable points. More than one bell may be wired up, each with its own circuit and its own push button beneath the slat, or several buttons may be connected through the signal lights to the same bell.

* * *

An electric-heating system which utilizes power that would otherwise go to waste has been installed in a school in a southern European city. The existing hot-water pipes and radiators are connected with a well-insulated water tank of 1,300-gal. capacity. In this reservoir electric resistances are built and at night are supplied with current which raises the water to well above the boiling point. The cost of the current is low because the water power used to produce it normally would go to waste. During the day the hot water is allowed to circulate through the radiators, its volume being sufficient to warm the rooms without using more current. The desired temperature is maintained by a thermostat.

* * *

At Portland, Oregon, a gas container 70 feet in diameter and 75 feet high, weighing 300 tons, was moved a distance of three miles. First, it was raised 15 feet and loaded on rollers. Then it was moved four blocks through the city streets and lowered 28 feet to a dock, whence it was moved upon a pair of barges. The barges were towed three miles to a shipbuilding plant, where the tank was unloaded and raised 26 feet, moved across newly-filled ground for a distance of 2,000 feet, crossing a railroad track and placed on its new foundation. It took 71 days to complete the work.

* * *

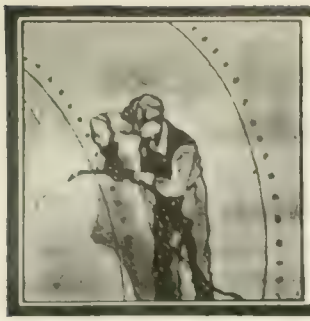
Shoe soles with metal coverings were made by Germans during the war—leather, cardboard, or wooden soles covered with aluminum or iron, not more than 0.01 mm. thick. The weight was the same, but they lost flexibility, became more solid and quite water-tight.

* * *

In concluding a paper to be read before the American Institute of Mining and Metallurgical Engineers, Messrs. P. D. Merica, R. G. Waltenberg, and H. Scott say that in the heat treatment of alloys of the type of duralumin the temperature of quenching should not be above that of the $CuAl_2$—aluminum eutectic, which is usually about 520 deg. Cent., but should be as near this as possible without danger of eutectic melting. The pieces should be held at this temperature from 10 to 20 min., and quenched preferably in boiling water. The hardening for most purposes may best be produced by aging for about five days at 100 deg. Cent. The hardening of duralumin during aging or tempering after quenching presents a very close analogy to that of steel, and the evidence in support of the theory is of the same nature and of approximately the same competence as that in support of the prevailing theory of the hardening of steel.

* * *

A simple device for improving the shearing strength of bolted joints in wooden structures has been brought out by Professor C. Forssell, of Stockholm. It takes the form of a corrugated washer, which is threaded on the bolt between the two pieces to be joined. The bolt is tightened against a pair of plain washers on the outside with sufficient pressure to force the corrugations into the wood. The strength of the joint is thus unaffected by the bolt hole, and depends on the friction between the two surfaces which are proportionate to the size of the washer and the depth of the corrugations. The strength of the joint is increased, according to Ingenioren, about twofold. The washers are known as "Bufo" washers, and made in various sizes, but all 1-16 in. thick, with corrugations about 9-32 in. high. In order to permit sinking into the wood, it is necessary to remove all knots at the joints to a depth of 3-16 inch. to 3-8 inch. The bolt is screwed up with spanners not less than 2 ft. to 2½ ft. long, and it is necessary to repeat the process after the first 48 hours and a further 72 hours.



WELDING AND CUTTING

Welding Jigs and How to Overcome Distortion

The Subject of Welding Jigs, and Various Methods for Overcoming Distortion as Presented by a Paper Read at a General Meeting of the British Acetylene and Welding Association

By C. S. MILNE

THE president, in opening the discussion, said:—

Mr. Milne is to be congratulated on the very thorough manner in which he has dealt with his subject.

This paper and his illustrations bear all the evidence of complete knowledge and careful preparation.

From begining to end he must have devoted a great deal of time and thought, taken a great deal of trouble and incurred a fair amount of expense in completing it. It is something out of the usual in these days to find a busy man who is prepared to do so much.

For all this we are grateful and trust he will feel sufficiently recompensed by our appreciation to-night and that which will no doubt follow from others when the paper is published.

The information he has given must surely be of great value to those concerned in the industry, and therefore I hope this paper will be widely circulated, because, as I am never tired of saying, the efficiency of the whole industry is more important that the super-efficiency of any one firm or system.

I think this idea is gradually sinking into the minds of those concerned in this industry. They should recognize it and give us all the encouragement and assistance we need.

I don't know that I can put forward from the practical point of view any useful criticism on Mr. Milne's statements. I will leave that to the experts. I dealt very faithfully with his matter in revising these proofs, and pointed out a number of small slips.

I mention this because Mr. Milne was grateful for having these trifling slips pointed out, and I am certain he will be equally grateful to anyone present who can point out any such slip on the practical side, because he is broad-minded enough to recognize that we are banded together in this association for the common object of advancing the industry and making all connected with it as efficient as may be.

Mr. Dixon said: I am sure that we are all very much indebted to Mr. Milne for his very valuable paper. It has been most interesting and we have learned a great deal from it.

There is one point, however, which I should like him to amplify, that is with reference to the statement that he considers it bad practice to weld and rivet the same joint. He does not qualify that in any way by saying whether he refers to all classes of metal whether under tension or compression. Take the case of welded seams that have been rivetted. It is well known that rivetted seams, no matter how well and carefully done, are not tight under external pressure unless the laps of the same are caulked thoroughly. Now, it has been a practice in a good many cases instead of calking, to adopt the system of welding the laps so as to effect a sealing. In the very valuable examples of modern welding which we have seen this evening the majority have been in connection with mines, and one, I think, in connection with trench mortar bombs. In these cases they we made principally, I believe, of steel plates. In the case of the mines, they are not subjected to tension or tensile pressure in actual work.

The only pressure which comes upon them is the pressure due to the depth under water in which they are placed, and the internal pressure is caused in both cases only when the fuse is started and disruption is required to give a violent explosion in order to cause destruction.

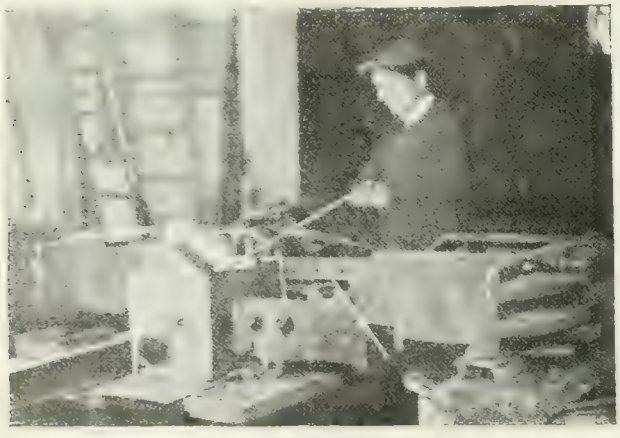


FIG. 34.

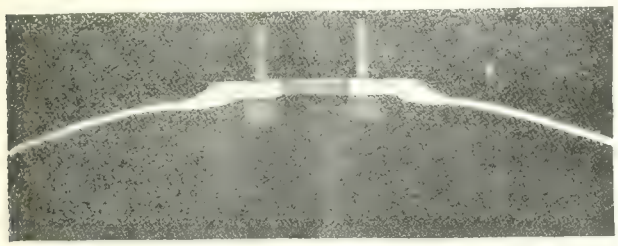
FIG. 36.

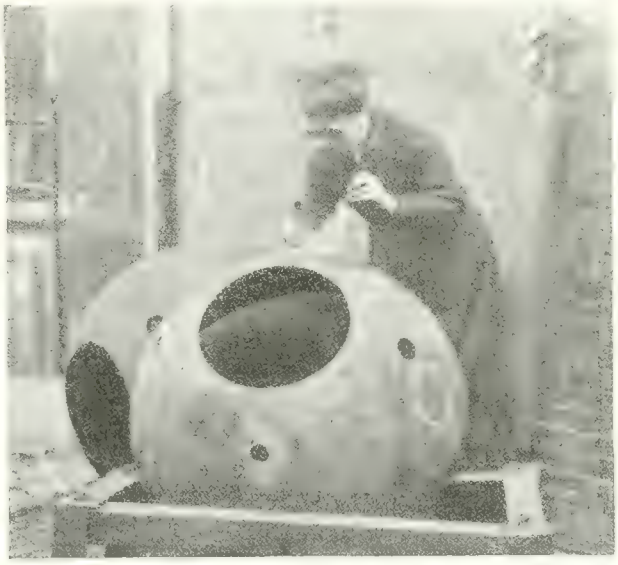
I suggest that in the case of steel vessels which are subject to internal pressure by means of steam or other ex-

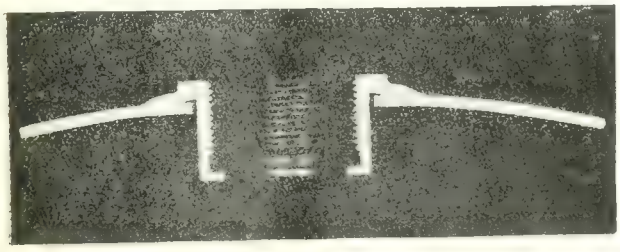
plosive gas, when we get a rupture in the plate, consequent upon sudden reduction of atmospheric pressure, a more violent disruption take place and a disastrous explosion occurs. In such a case as that a large number of engineers consider that when a steel plate is welded the weld should be covered by means of a butt strap and when such things as hemispherical ends are welded to a cylindrical vessel, that they should be reinforced by through stays.

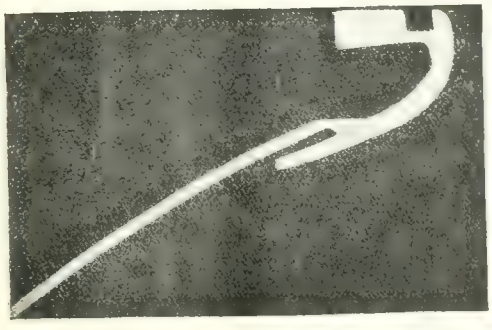
In these circumstances I should like to ask Mr. Milne whether in his valuable experience he considers it absolutely safe and desirable practice that steel plates of ordinary commercial quality, say 26 to 30 tons per square inch, which are subjected to internal pressure by means of steam or other explosive gas, are absolutely safe without being reinforced in such a way as I have suggested?

Capt. Harley said: Although I speak with some diffidence as a member of









SOME INTERESTING EXAMPLES OF WELDING.

Mr. Milne's firm, it did occur to me, as one having had a very long experience in this class of work, that his remarks upon riveted joints might be subject to some elasticity. If you take the cover of a vessel which has to be sealed and you rivet or bolt that flange to resist the pressure of the fluid or gas against the cover, you would probably have to caulk also, but it might be preferable to seal the edges by welding.

The welding is useful on the edge for this purpose of sealing, but would not necessarily be any good against intense pressure on the area of the cover. In regard to the last speaker's remarks about mines, you must consider the question of disruption in relation to that of welding, because if your weld were to yield at the moment of destruction the mine would be absolutely useless. The hemispheres would simply come apart and would not have any retentive effect at all against the explosive charge.

You do not have longitudinal stays in mines. C. S. Milne & Co., Ltd., have made a great many mines which I do hope went off effectively, and I think we may say that the hemispherical welding, without the use of stays has been a success.

Mr. J. J. Gardner asked: In the case ipulation of the blowpipe by one of the workmen depicted by means of the lantern slides which illustrated the lecture, and asked for some particulars as to why Mr. Milne liked his welding on the work which had to stand tests which were beyond the ordinary?

Mr. Metcalfe enquired if Mr. Milne made any provision in the cutting machine, shown in Fig. 31, against the rubber tubes getting tangled?

Mr. Pickett said: Can Mr. Milne give us any information with reference to welding fractures in copper? This question particularly interests me and I should very much like to know whether Mr. Milne has any information on the subject.

Mr. Albert Hoddle said: I am sure we are all very grateful to Mr. Milne for the way in which he has dealt with the subject of his paper. He has not only described the difficulties he has encountered, but he has shown us the actual way he has solved them. I would like to ask just one question: Does he anticipate being able to go further into his machine welding device or shall we have to wait for another war?

The president: I know Mr. Milne would like to have a few more pertinent questions. I was afraid when we started that we should have to adjourn the discussion to another meeting.

Mr. Thomson: This is the first time I have had the pleasure of meeting this association, and as comments have been invited, I should like to say that I failed to recognize among the many slides one that has dealt with the component parts of motors, or castings connected with internal combustion engines. We have to recognize now that motor transport is a very great power in the land and a great deal of acetylene welding has to be done with these various parts. I am interested in that particular industry and I would like Mr. Milne to let me know whether he has any experience in connection with the welding of the crowns of cylinders of internal combustion engines that have been fractured?

If a job of this description could be made successful by welding I daresay I could find him some work to do.

The president: I will now ask Mr. Milne to reply to the question which have been raised.

Mr. Milne, replying to Mr. Dixon's query and also to Capt. Harley's remarks, said: My point was, if riveting is satisfactory, why weld? and if welding is good enough, why rivet? On the question of chambers that are in excessively high tension due to internal pressure, I think that you had much better stick to your riveting and say nothing about the welding.

To be Continued

FIG. 26.

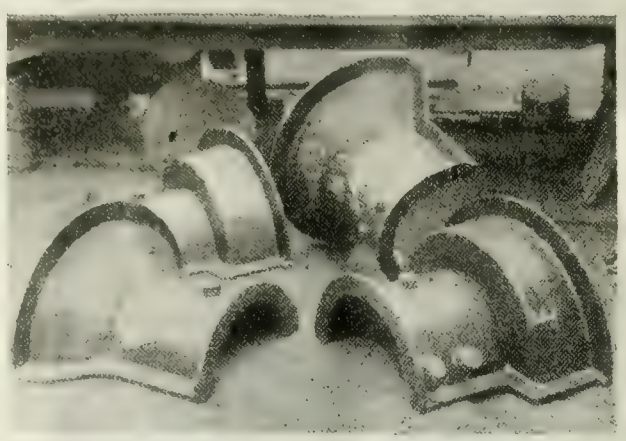
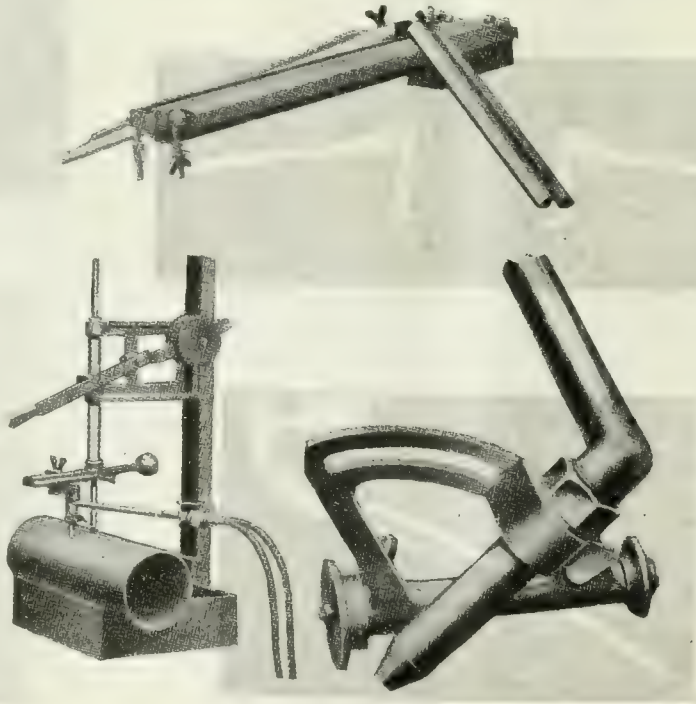
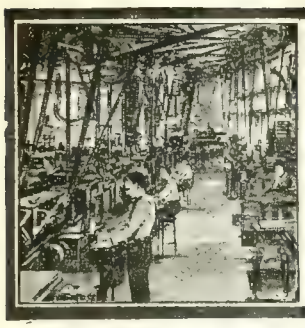


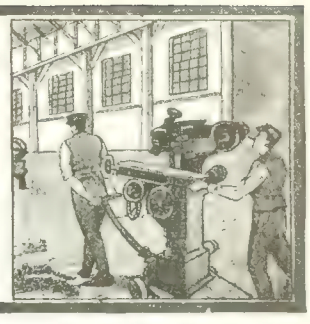
FIG. 27.



FIGS. 28, 30, AND 32.



DEVELOPMENTS IN SHOP EQUIPMENT

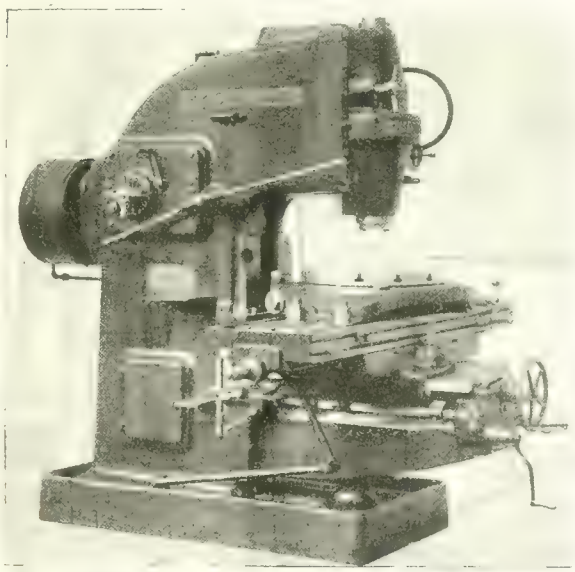


No. 4 VERTICAL HIGH POWER MILLER

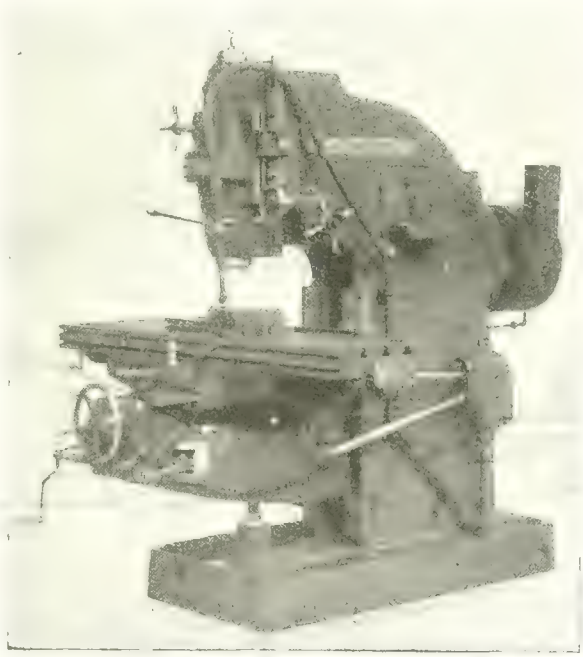
As a result of the success attained by the new No. 5 High Power Horizontal Type Cincinnati Milling Machine, the Cincinnati Milling Machine Company has placed on the market a heavy vertical machine of similar design, embodying the same features. This new machine is intended for extremely heavy work and it patterned after the No. 5 in all those elements which are common to both machines.

For die work, some classes of tool room work and many manufacturing operations, the vertical spindle milling machine has many obvious advantages over a machine of horizontal type. Chucking the work, in particular, is often simpler and the work is more accessible and very easily observed. Also, in combination with a rotary milling attachment the vertical spindle machine becomes a continuous miller.

The strains set up by the cutter in the vertical machine, particularly when using the large diameter face mills



BACK VIEW OF THE MACHINE.



GENERAL VIEW OF MACHINE FROM OPERATING SIDE.

for which this machine is designed, are just as severe as those which must be taken by the horizontal machine of the same horse power rating. However, all horizontal machines are provided with braces for tying the upper part of the machine carrying the cutter and the knee which carries the table and the work, together. There is no such provision on a vertical machine and the strains must be absorbed by the knee and column and those parts must therefore be made very strong and solid to take heavy cuts at high rates of feed. The illustrations will indicate that the column of this new machine has unusually great depth and width and the walls are thick and well ribbed.

The Knee

The knee is the other member which must absorb these same strains and also carry the entire load of the table, saddle, fixture and the work. This portion is well ribbed, and so designed as to allow ample thickness of walls. The openings are small and are placed as far as possible in the neutral sections. It is connected to the column by rectangular bearings with square gibs and narrow guides which together with the rigid construction of the knee itself provides ample strength for the maximum cuts and heaviest load this large machine is designed to carry.

The Saddle

The saddle is long and its extreme width provides an ample bearing for the table. Its bearings on the knee are again rectangular, square gibber and with a narrow guide which provides good sliding conditions even when the table is heavily loaded, and at the end of its travel. This square gibbing also enables the incorporation of a very effective clamp for securing the saddle to the knee. This clamp is, in fact, so effective that no special stops or other facilities are required for holding the saddle in position when heavy irregular cuts are being taken. The saddle details are shown on figure 2, which also illustrates the liberal proportion of the feed gearing, the connection of the power quick traverse transmission and also the connection for the drive for the circular milling attachment shown in the heading of this article. This circular attachment is also entirely new, designed of strength and general proportions to suit the machine. By using this arrangement the machine may be converted into a continuous miller, at the same time allowing the use of the table feed independent of the rotary feed, and also the use of the power quick traverse for both the machine

table movement and for rotating the attachment table, the operator being relieved of all hand adjustments.

The Table

The table of the machine is 19 in. wide, has a working surface 68 in. long, with three T-slots ¾ in. wide, providing ample clamping facilities. In order to resist as far as possible the warping effect of clamping bolts when holding the work for heavy cuts, the table has been made of unusual height, box section, and has a large number of ribs to give it added stiffness.

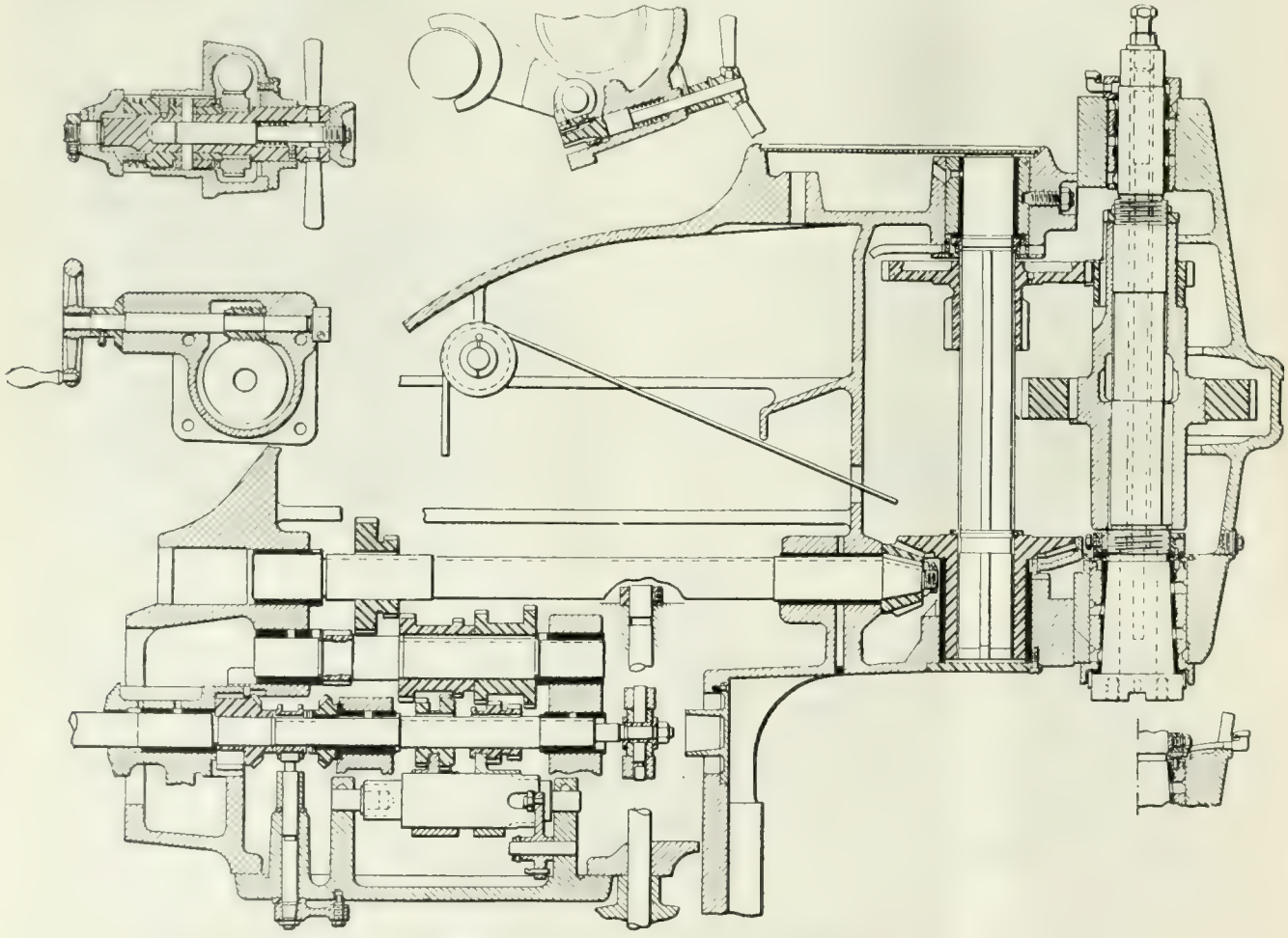
The main driving pulley runs on ball bearings and is mounted on a bracket fastened to the column which relieves the driving shaft of all belt pull. It drives the machine through a large powerful friction clutch which is operated by the main starting lever from either the front or rear of the machine. When the clutch is released to stop the machine an automatic brake is engaged and stops the spindle almost instantaneously. A belt guard conforming with the modern safety laws is also provided. The main driving pulley runs at a fast speed which allows the use of a high speed motor for either the belted or geared driving arrangements.

Speed Changing Mechanism

The speed changing mechanism is similar to that of the No. 5 machine except that the spindle and back gear shaft are turned to the vertical position. One of the novel features of this machine lies in the fact that this is accomplished by incorporating in the vertical machine the same large face gear and the same powerful mounting of the spindle as in the horizontal machine. The back gear shaft which is parellel with the spindle, and therefore, also in a vertical position, is driven through a pair of bevel gears, and back of those the entire drive is the same as on the horizontal machine. The speed changes are made through selective sliding gears. There are no tumblers in the machine. All shafts are hardened. This back gear shaft has four integral keys on which the back gears slide. This transfers the sliding feature from the spindle to the back gear shaft and eliminates the difficulty resulting from a construction that requires the spindle to slide through the gears. The gears on the back gear shaft may be selectively brought into mesh with the gears of the spindle and no matter which set of gears is engaged, when the spindle is adjusted vertically they may slide along with the head and retain their driving engagement at all positions of the head. The spindle itself has no gears on it but is surrounded by a sleeve, the lower end of which is slightly tapering and fits snugly on the spindle to which it is keyed at this point. This construction for all practical purposes makes the spindle and sleeve one piece, having the effect of merely enlarging the diameter of the spindle, and at the same time placing all strains due to driving on the sleeve to which the face gear for the slow speeds and secondary gear for the higher series of speeds are keyed. When the head is adjusted up and down these gears are carried with it and there is a connection between the head and the driving gears on the back gear shaft which moves them up and down to correspond.

The Spindle Head

The spindle head is square gibbed to the column and carries both bearings of the spindle in fixed positions in relation to each other for all positions of the head. The quick head adjustment may be made through the pilot wheel at the right side of the column, one turn of which moves the head 6 inches, the full adjustment. There is also a slow adjustment provided through a hand wheel (worm and worm wheel) which is brought into engagement



GENERAL SECTIONAL VIEW OF THE MECHANISM.

by means of a fine tooth clutch operated by a knob in front of the pilot wheel. There is a micrometer stop and also a micrometer dial provided. The details of the head are shown on figure 3.

The Feed Mechanism

The feed mechanism, similar to that of the No. 5, is placed at the side of the knee and the feed changes are made by a single lever operated from the front through a system of sliding wears. The changes may be made instantaneously from one feed to any other by merely shifting the position of this lever. Its location and the ease with which the feeds may be changed also makes the fast feed of 30 inches per minute available as a quick traverse for cross and vertical adjustments. The standard feed range is ¾ to 30 ins. A slower or faster rate may be furnished when desired.

The individual feed levers for table feed control, each of which starts, stops and reverses its corresponding feed, also at the same time indicate the direction of movement and these levers are duplicated at the rear of the machine so that the feeds can be controlled from a position behind the table when the size of the work makes this position desirable. The table feed lever has five positions controlling the starting, stopping and reversing of the table feed, and also the quick traverse of 100 ins. per minute for the longitudinal movement in both directions. The trip mechanism is arranged for intermittent feed, this feature being made available by setting the necessary dogs to suit the work and the intermittent feature may be used for feeding in either direction. This feature saves much time on work in which the cut is intermittent, the fast and slow feeds being controlled entirely by dogs, automatically bringing the quick traverse into action at all times except when the feed rate is being used. This is one of the outstanding features of this new machine and is a great time saver. One of the cycles of movement which is especially useful in the vertical machine is the continuous reciprocating cycle. The application of this cycle is as follows:—Assume 2 pieces of work on the table some distance apart and assume the cutter in the space between the 2 pieces. The operator starts the machine; immediately the table moves quick until one of the pieces has arrived at the cutter, when the dog trips to the feed rate, the work is fed under the cutter and then the table is reversed and is returned at the quick rate until the cutter arrives at the next piece, when a second dog trips to the feed rate and after this piece has been traversed the table is again reversed and a piece which the operator has in the meantime chucked in the other fixture, is again brought to the cutter and so on. This is continuous reciprocating milling, the operator chucking a piece in one fixture while the machine is milling the other, the entire operation of the machine being automatic. Another feature is that the table and cross feed can be used consecutively, being dog controlled. The design of the trip members is such that with the dog in the path of the trip plunger the power feed can be easily reversed and the table fed in the reverse direction,

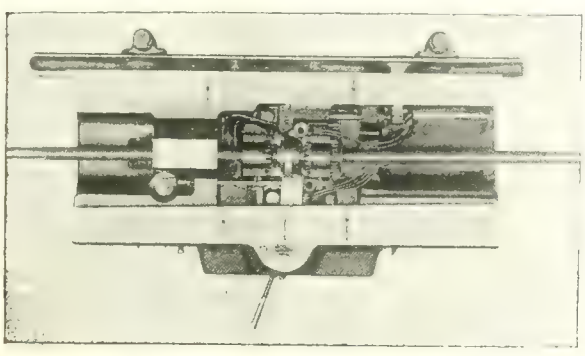


FIG. 3 PLAN VIEW OF THE SADDLE.

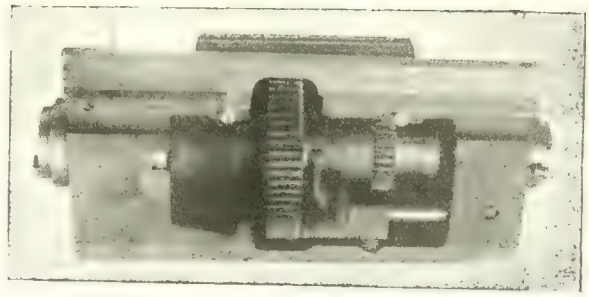


FIG. 2 DETAILED VIEW OF SPINDLE HEAD

so that the work can be finished in a square or rectangular path in either direction.

The Pump System

A centrifugal lubricant pump with a capacity of 11 gallons per minute is supplied as regular equipment for cooling the cutters. A geared pump placed in the pulley bracket provides automatic lubrication of all mechanism in the column, and several centralized oiling stations provide quick and convenient oiling facilities for the bearings in the knee, saddle and table. Another feature is that it is not necessary to set the table in a certain position for oiling the inside parts of the saddle and table and their bearings, as these parts may be oiled with the table in any position whatsoever.

Figs. 3 illustrates the spindle head detached and shows the two main gears and the gear shifting mechanism, as well as the method in which the gear assembly slides on the back gear shaft to allow for spindle head adjustment.

The remaining illustrations are self-explanatory.

A service of genuine worth is rendered to its patrons by one automobile manufacturing company. When it is reported to the central factory that a car has been lost or stolen, the factory history is consulted and the car's secret markings collected. In bulletin form these markings are then sent regularly to the company's dealers and garage men, who know that a thief always erases the engine mark but usually overlooks the number on some small, inconspicuous part. In this way the company has been able to recover hundreds of stolen cars in the last few years.

A claw hammer of the usual kind with a wood handle may be made very strong for heavy work, such as pulling very large nails. This can be done by sawing out an opening in the handle from the hammer head back past the centre of the handle an inch or two and inserting a strip of very narrow old steel buggy tire and securing in place by drilling small holes through both handle and buggy tire strip. The proper place for the holes is just back of the hammer head, one in the centre, and one just back of the centre an inch or two from the end of the buggy tire strip. Sometimes the drilling may be dispensed with by selecting a strip of buggy tire with bolt holes in the proper places.

The term shell shock has misled many persons to believe that it is due to the profound impression or shock produced on the nervous system by the detonations of high explosives. No doubt, there are cases of actual brain or nerve injury due to concussion of the air accompanying shell explosions, but these mechanical causes are a great deal less frequently responsible for war neuroses than the mental effects of general war strain. It is remarkable that these war neuroses, common as they are among privates and officers alike, are seldom found in men who have been actually wounded. Perhaps this seeming anomaly is due to the actual wound shock offsetting the mental impression affecting the controlling nerve-centre in such cases.

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PRINCIPAL CONTENTS

Tearing Down Tariffs

AT the gathering of the Liberal party at Ottawa a few days ago the matter of tariffs came in for some very strong talk. The broad statement was made that tariff should be taken entirely off some lines such as agricultural machinery, tractors, etc.

The trouble is that when people come together at times such as the Ottawa gathering, they are apt to talk in glaring generalities without getting down to real facts and facing all the conditions.

Taking the tariff off of any line and throwing a Canadian shop into competition with the world would mean, if there were to be any degree of fairness in the matter, that the Government should see to it that that shop has all the advantages that the competing manufacturers have. There should be the same ability to buy raw materials at the first cost, equality of carrying charges, etc. There are a large number of things to be considered, but in the heat of a convention called for the purpose of framing a platform they are generally overlooked.

The majority of the Canadian manufacturers are not of the Haman's gallows type of tariff makers. They are reasonable. They are not clamoring for tariff as a bonus for inefficiency. They have learned that it is possible for Canadian goods to be made good enough to enter the markets of the world.

But those who propose to bring into effect a tariff in Canada that would wipe out all protection and all tariff, regardless of the amount of revenue it would destroy in these days of high taxation, must think seriously of what they are about if they do not wish to strike at the root of much of Canadian industry.

What is needed, and what seems very hard to secure, is that there should be a scientific and careful study of the whole tariff field in a scientific and thorough manner. Political conventions have vague notions on tariff matters, for the simple reason that those who attend have not studied the matter in a big enough way.

A Strong Indictment

AT a time when the household preserving industry should be in full swing, the supply of the most important ingredient, sugar, has been ruthlessly suppressed, presumably by the large interests who can control the supply. The authority for this statement is Dr. R. J. McFall, the Cost of Living Commissioner. Without any attempt at equivocation, he states that sugar is being deliberately kept from the housewife in order to prevent her competing with the canning combine.

In support of this he shows that the amount of sugar being refined in Canada is more than sufficient for the needs of the country, and the imports are in excess of the exports. An advance takes place in Canada in spite of the fact that it remains stationary in New York.

It would seem that here is a clear case for Governmental action. With the amount of discontent and unrest apparent throughout the country, conditions such as are here disclosed are nothing less than criminal. People naturally think if these things are true of one type of big business they are true of all.

Will those in power be able to take their eyes off the political situation long enough to look into a condition which affects so vitally the pockets of the voters?

THE latest horror to be perpetrated on a long suffering public is an actors' strike in New York. However, the tired business man can pluck up courage. The chorus girl is sticking to the job.

* * *

THE Cost of Living Commissioner says that the sugar trust is boosting prices to help the canners' combine. We trust the people will combine to can both the canners and the sugar trusters.

* * *

That the state may have a sufficient number of tractor drivers to cultivate the maximum amount of land, and so increase the food supply, the California State Board of Education has been conducting emergency classes in tractor operation in the rural districts. The course given lasts three weeks and costs only $2.50. The first week, the students are taught the theory and principle of gas engines; the second week, the assembling and disassembling of tractors, their operation and repair, and the third week they drive tractors in the field.

* * *

It would seem that the phenomenon of growing old has really nothing to do with the number of years that an individual has lived, but depends principally on the extent to which he has conserved his recuperative powers. The human body wears out in two ways, i.e., either by long-continued use or by long-continued disuse. In the former case it is like bending a wire back and forth in one place until it breaks, and in the second it is the atrophy of organs or functions through disuse. The only way to stave off old age is to eliminate all forms of abuse and live as Nature intended us to live.

Advice to the Draftsman; Get Out of it

By Thernaldus

THE draftsman's life must truly be a hard one if all is true that has appeared in two previous numbers of CANADIAN MACHINERY and unfortunately, it is. From the writer's point of view the unsatisfactory state of affairs existing to-day is due to several causes.

First the draftsman himself. "The attractive surroundings and cleanliness of the work itself," undoubtedly appeal to many youths and to their parents. This is responsible, perhaps, for the number of so-called draftsmen seen to-day pushing a pencil who might better be counter-hopping in a dry goods store or behind the wicket in a bank. The same remark also applies to the product turned out by engineering schools in vast numbers, with sheepskins enabling them to design everything from Quebec bridges to cast iron bath tubs. For among them too many are found who are utterly unsuited for any engineering profession. This state of affairs is due perhaps to the glamor of the engineering profession, but more likely to the idea unfortunately mistaken that the engineer's stipend is of fabulous proportions.

However, if a man is not suited mentally for mechanical pursuits he might better stay out of them and get into something more to his capabilities, leaving the field open to those of the proper talents, to their better advantage.

The draftsman himself is also at fault through his mental inertia or laziness, call it what you will. The drafting room to a man of ambition and who is willing to work is but a step to something better. Take a look around any drafting room and you will find very few men who have reached middle age still bending over the board with tee square and set square. Where they go has puzzled the writer for some time, but an explanation might be found in the fact that the earnest ones desiring self improvement usually reach the designing engineer's office or some other sphere where their capabilities have better scope for their display, while the inefficient ones drop out of sight and are found in other occupations.

Not only is the draftsman himself at fault, but his employers are not altogether blameless. "One of Us" says it takes an average of four years to make an average draftsmen. This is all too true, and when the four years are up his knowledge is usually very limited and confined to whatever he may have been working on most of the time. It should be recognized that the apprentice (we may call him that though not articled) draftsman is entitled to a reasonable amount of educational opportunity aside from that which comes to him through his particular work. "One of Us" lays stress on shop training and this point can only be emphasized in the strongest of terms, for a draftsmen without shop knowledge is as useless as a doctor without a knowledge of anatomy. There is another side of the question of education which should be dealt with equally with the practical, however, and by this I mean the theoretical side of whatever branch of engineering is applicable.

It goes without saying that a mechanical draftsmen should have a good knowledge of machine design in all its parts, should know the principles of mechanics and their application, and should have a sound knowledge of materials and their strength. The electrical draftsman is in a somewhat similar position but his need for theory is even greater. In some cases his knowledge must approach that of an engineer. The structual draftsman, too, if he does not wish to remain a detailer on that everlastingly monotonous job of structural detailing, must have a knowledge of the theory of framed structures.

Where will the apprentice draftsman gain this specialized knowledge. Through his superiors? Yes, if they are willing as they usually are, and if the boss is acquiescent. Through home study? Perhaps, but it is a lonely job. Through technical schools? Yes, by all means, and it should be the employer's part to give a bit of encouragement and incentive.

The actual production of a pretty drawing is not so important. The neatest letterer in the room is usually given the job of lettering shop signs, etc. More to point though is an understanding of the principles of projection and the construction of a neat accurate drawing. How many draftsmen know whether they are drawing in the first or third positions?

The argument is often heard in the drafting room as to whether the college graduate or the practical man from the ranks is the better man and the discussion at times becomes quite bitter. The inconclusive nature of these debates is a guide to the equal value of both and the proper training for the draftsman, or, the engineer whether from college or from the practical side of the fence will be found in a combination of both theory and practice.

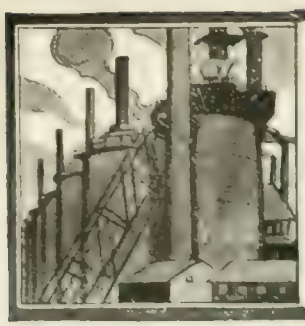
For the mechanic, the drafting room offers a means of acquiring the elements of engineering practice and this supplemented by his own efforts and study should make him a REAL engineer.

The engineering graduate fresh from the halls of learning has to, or should, reverse the process and go first to the shop, then the drafting room and from thence where he lists.

For the youth ambitious to become a draftsman the shop training as proposed by "Engineer," in one of the former rhapsodies on this subject, is absolutely essential and after he has entered the realm of blue print and tracing cloth his education should not stop, but change, and should smack more of the theoretical, gained by study at home, night school or otherwise.

The three elements, practical knowledge, theory and draftsmanship, should go together much as capital, labor and brains; all three necessary to the achievement of success and all as necessary as are the three legs of a milk stool, n.b., this simile is not mine.

After all this suppose we have a finished draftsman or really a designing engineer and he comes for advice regarding the remuneration offered for his really worth-while efforts. If he asked the writer's advice he would say: "Get out of it."



MARKET DEVELOPMENTS

There is a Fair Amount of Business Moving

While Not so Active as Previous Week, Machine Tool Trade Shows Steady Business—Steel Warehousemen Report Good Business

THE general feeling among machine tool dealers and steel warehousemen is that business is satisfactory, though not quite as lively as during the previous week. There is some hesitancy still being shown by machine tool purchasers regarding the probabilities of labor troubles interfering with business later on. While there are plenty of machinists available now, the fact that in many places molders are still on strike makes it impossible for the machine shops to be fully engaged.

There have been no changes in steel prices since last week. That a change must come before long, and that when it does it will be upward, is the opinion of those interested in these lines. There is still a difference of opinion as to the probabilities of an advance in plate prices, but the fact that mills are operating at 75 per cent. capacity and will not promise delivery before last quarter would seem to preclude the idea of a drop in prices.

Pig iron still shows advances. Many furnaces are now booked up for the rest of the year and show no anxiety to book business for next year. What bookings have been made for first quarter have been at an advance of from $1 to $2 a ton over present prices.

In the scrap market the scarcity of steel scrap is still the feature, and prices for heavy melting continue to advance. Dealers are holding on to what they have for better prices, and sales at $23 per ton have been reported. Cast scrap has reached a point in some districts where furnace men are buying low grade pig as being cheaper than scrap.

BUYING OF MACHINE TOOLS KEEPS STEADY

TORONTO.—While business in the machine-tool trade is fairly active, the still unsettled conditions of the labor market is having its effect on buyers. One dealer reports having placed twelve machines last week, part new and part second-hand. The general feeling is that there is nothing to complain about in this line.

Considerable interest is being taken by dealers in the buying now going on at Walkerville, at the plant of the Canadian Products. While the proximity to Detroit is somewhat of a handicap, the Canadian dealers are getting some of the business. Some lines of course must be purchased through Canadian houses where they have the sole rights of the territory.

The steel market is at the moment practically stationary, but as this is not a natural condition, a movement in prices is expected shortly. That this movement is to be an upward one is pretty generally believed.

One feature of the situation is that plate mills now refuse to promise delivery on orders before the last quarter. A few weeks ago delivery could be obtained in two days, if required. The mills are now operating about 75 per cent. capacity, which is high. This would seem to be against the idea that plate prices would drop, although that is still being entertained by some well-informed men. There is a good quantity of plate still being brought into Canada to fill existing contracts in the shipbuilding and marine engineering lines.

Warehousemen report very good business, which is keeping their stock turning over. The railways are buying freely. August is generally looked on as a dull month so the situation may be called very satisfactory.

There is practically no change in the scrap situation since last week, the scarcity of heavy melting steel still being apparent.

AUTOMOBILE INDUSTRY IS RESPONSIBLE FOR MUCH BUYING

(Special to Canadian Machinery)

NEW YORK, Aug. 11.—The volume of machine-tool buying is steadily increasing, but a large proportion of the orders and inquiries continue to come from the Central West and particularly from the automobile industry.

The White Company, of Cleveland, manufacturers of trucks and passenger automobiles, has made inquiry for 250 to 300 tools for an addition to its plant and other large buying by auto makers is in prospect, while the day-to-day business in the Detroit territory makes up a very satisfactory aggregate for many tool builders.

The Hudson Motor Co., Detroit, will build a large plant at Detroit for the manufacture of Essex cars and perhaps $1,000,000 worth of equipment will be required, while buildings will involve about an equal expenditure.

Dodge Brothers have purchased a large tract of land near Detroit for new manufacturing capacity, and it is rumored that this concern may erect its own steel plant and sheet mills. Ground will be broken soon at Marysville, Mich., near Port Huron, for the new plant of the Wills-Lee Company. This will be one of the largest automobile plants in the country and many millions of dol-

lars will be invested. The Canadian branch of the company will be located on land below Sarnia, Ont., which was formerly a part of the Indian Reservation.

One of the largest projects in the shipbuilding field announced since the end of the war is a $5,000,000 ship repair plant to be built near Havana, Cuba, by the Cuban Government. Monks & Johnson, Boston, Mass., contractors and engineers, who laid out the Alameda, Calif., plant of the Bethlehem Shipbuilding Corporation, and who have done much other important work for the Bethlehem interests, have received the construction contract. Equipment for plate shop, forge, machine shop, etc., will be purchased in the United States.

A maker of grinding machines and boring mills has advanced prices 5 per cent., but no further price advances are noted, other than those reported a week ago. Prices are firm, however, and there is practically no tendency among sellers to make concessions. The Standard Oil Company of New Jersey early in the year got quotations on about 75 machines for shipment to the Roumanian oil fields, but postponed buying, presumably on account of high prices. It is quite certain that the company now will pay much more, the list having been revived, as few sellers need business as badly now as when the list first came out, and the temptation to cut prices will not be so strong.

POINTS IN WEEK'S MARKETING NOTES

Steel plate mills are operating at 75 per cent. capacity and will not promise delivery before last quarter.

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Machine-tool business is giving dealers satisfaction. Some big buying just now at Walkerville.

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The steel output for the month of July was equal to 75 per cent. capacity of mills.

—

Scarcity of steel making grades still feature the scrap market. Cast scrap price in some cases up to that of pig iron.

—

Large quantity of ship and boiler plate still being imported into Canada to fill contracts.

STEEL OUTPUT FOR JULY WAS 73 PER CENT. OF CAPACITY

Special to CANADIAN MACHINERY.

PITTSBURGH, Pa., Aug. 14.—The volume of orders flowing to the steel mills keeps up very well, easily exceeding the current production, but an element of uncertainty has been injected into the situation, in that some of the buying may be prompted by fear that mills will have difficulty in making deliveries later in the year, either through their having too much business or through there being strikes. The steel producers think it highly improbable that the efforts of the American Federation of Labor, in the direction of having a general strike in the steel industry, will lead to anything, but in this matter it is not a question of what the producers think, but of what the buyers have in their minds. Strikes as affecting steel production, moreover, are not all in the future by way of probabilities or improbabilities, for the strikes of railroad shopmen have curtailed pig iron and steel production materially in the past ten days, considerable parts of the South Works and Gary Works in the Chicago district having been thrown idle through lack of transportation facilities, as well as practically the entire Newburgh works, Cleveland. The three plants mentioned are all controlled by the Steel Corporation. On the whole, steel mill labor itself appear sto be contented and to realize that it is well treated. The Steel Corporation in particular asserts that its men are well satisfied with their treatment, and the Steel Corporation takes great pains to ascertain the exact facts in this matter. Two incidents may be mentioned. The Leechburg and Vandergrift works, near Pittsburgh, of the corporation's sheet and tin plate subsidiary, employ about 2,000 men, and recently a mass meeting of these men gave an enthusiastic viva voce vote to a set of resolutions to the effect that they intended to keep at work "under present conditions" and that "we resent any interference by any union, outsiders, or paid agitators." Another incident is that at two independent tin plate plants the men asked the management to give them, not the Amalgamated Association, the union scale, but the open shop scale of the Steel Corporation's tin plate plants.

Steel Prices

The whole country has been much wrought up lately over the high cost of living and deep interest is taken in the efforts being made by all branches of the Government to bring it down by all methods available, including the punishment of profiteers. All price advances must prove very unpopular. Hitherto there have been divided counsels in the steel trade as to the propriety of advancing prices at this time, with the Steel Corporation and some of the independents positively opposed to there being any advances. In view of the state of popular feeling it is likely that the minority, which has been talking higher prices, will change its attitude.

In the pig iron market several price advances have been announced. Alabama furnaces state that they are back to the March 21 price of $26.75 on No. 2 foundry iron, which would put them in an impossible position as to sales in much of their territory when various northern furnaces, with much smaller freights, are still at $26.75, furnace. Chicago district furnaces are reported to have advanced their prices $2 a ton, and two Cleveland furnace interests report having made an advance of 50 cents. The Pittsburgh market is merely firm at the old price. The price advances are probably simply "on paper," the furnaces making them being sold up for a time. If 55 per cent. of the merchant furnace capacity of the country can advance prices without any of the idle 45 per cent. coming into blast then there is something possible that has never occurred before in the history of the industry. Usually the market is rather wobbly as idle furnaces come into blast, because they are not punctilious as to selling prices when they are accumulating a backlog of orders upon which to blow in.

Steel Production

The monthly report of the American Iron and Steel Institute shows that in July 2,508,176 gross tons of steel ingots were produced by 30 companies, which in 1918 made 84.03 per cent. of the country's total output of steel ingots. This means that in July the industry as a whole produced at the rate of about 35,700,000 tons per annum, or at 73 per cent. of capacity, taking the latter at 49,000,000 tons. This compares with rates of 67 per cent. in June, 54 per cent. in May, and 65 per cent. in April. Production has been increasing almost as rapidly as formerly it was decreasing, the low point, about 50 per cent., having been struck at the middle of May. In view of the dearth of orders for rails, plates and structural shapes it does not seem probable that the present rate of steel production can be greatly exceeded in the near future. Some departments, particularly the lap weld departments of the pipe mills, are oversold, but that does not help the departments that are short of orders.

Steel Corporation Tonnage

The Steel Corporation reports 5,578,661 tons of unfilled obligations on books at the end of July, indicating a gain of 685,806 tons during July, against 610,545 tons gain during June, and losses averaging over 600,000 tons a month in the six months preceding June. The corporation's shipments in July may be estimated at 74 per cent. of capacity, and as the increase in unfilled obligations represented about 63 per cent. of capacity the total tonnage entered in the month appears to have been about

127 per cent. of capacity, against about 117 per cent. in June and only about 20 per cent. in May. The figures, it must be remembered, include contract obligations, and thus give little suggestion as to shipping orders, which include specifications against contracts. The monthly tonnage reports indicated extremely light business during the six months preceding June, but the shipments were fairly good, being chiefly against specifications on contracts entered long before.

Exports

February marked the low point in iron and steel exports from the United States, 234,793 gross tons. Afterwards there was continuous improvement, June showing 544,580 tons, the largest amount for a month since December, 1917. Since about the end of June export demand has not shown distinct signs of increasing, and in some respects it has fallen off a trifle, though the latest reports suggest a revival. On the whole, however, it is probably not out of line to take it that the June exports are a fair guide to what may be expected in the matter of exports for some time to come, and general comparisons may therefore be indulged in. First, it should be noted that the iron and steel exports as reported by Washington include scrap, pig iron, unfinished steel, the various rolled products, and such manufactured goods as cast and wrought pipe, wire and nails, nuts and bolts, etc., as well as some castings. Accordingly, while comparisons can be made between months and years, comparison cannot be made between the total exports and the total production or the capacity. Eliminating pig iron, wrought iron and castings, the steel exports are left and can be compared with steel production and capacity. The June exports of steel represented a rate just a trifle under 6,000 000 gross tons on the basis of finished rolled steel, the productive capacity in which is about 37,000,000 tons a year, so that the exports of steel represented 16 per cent. of the capacity. Production in June was at about 67 per cent. of capacity and thus the exports represented about 24 per cent. of the production. In 1912, the best calendar year for steel exports before the war, the exports amounted to about 2,400.000 tons, and that was about 10 per cent. of the production. There are two ways of looking at most things. One may say that steel exports now are two and one-half times the best exports before the war. One may also say that while the present capacity of 37,000,000 tons is 14,000,000 tons greater than the production of 1912, the exports have increased by only 3,600,000 tons, and as there is no evidence that they are going to be much larger, it is more readily seen how idle was the talk during the war that afterwards the export demand would take care of the increase in capacity produced by the war.

MALLEABLE SELLING HIGHER

Advices from almost all centres show further advances in pig iron prices. Furnace capacity for 1919 is fully booked up. Malleable iron for first half brings higher price. Following are reports from U. S. points:

Chicago.—Foundry interests are evidently seeking to get as much iron as possible before prices advance again. 1919 production of furnaces will all be booked up before the end of this month at present rates of selling. Iron for 1920 is quoted at $2 over present prices.

Boston.—Sales through New England dealers approximate for the past week 10,000 tons. Prices have fluctuated, in some cases stiffening, concession being given in others. The general trend is towards further stiffening, with enquiry good. Some sales for 1920 have taken place, but the price has not been given out.

New York.—Enquiries are in excess of capacity in this district. A large tonnage for export could not be quoted on owing to lack of iron. For 1920 first half delivery, about 40,000 tons are asked for, but few furnace interests are willing to quote on next year delivery, feeling the labor market is too uncertain.

Pittsburgh.—The tendency of consumers is to cover themselves for their future requirements before prices get any higher. Steel making grades have been in demand, although steel makers are not busy. A quantity of low phosphorus iron was bought for $39 to $40 from a valley producer, while a sale of 3,000 tons of basic at $25.75 is reported.

Buffalo.—Furnaces are booked up in most cases for this year's delivery, and at least two are out of the market. Some 1920 tonnage has been sold, the prices reported being malleable $29; No. 2 foundry $28; No. 2X foundry $29, and gray forge $27.50.

Cleveland.—There have been good sales of round tonnages during the past week, due mostly to the talk of impending higher prices, consumers being anxious to get covered. Enquiry for 1920 is fairly brisk, but sales are few. Furnace stocks have been reduced more in the past week than in any preceding week this year.

Cincinnati.—There has been little business done here although prices are favorable, last quarter delivery being quoted at $26.75 Birmingham for 1.75 to 2.25 per cent. silicon. First half enquiry for foundry iron is coming out, but no sales are reported so far.

St. Louis.—Brisk business involving good sized tonnages has been the feature of the market here this week. Consumers who had covered on estimated business find it necessary to secure more material on extra orders. Sales are ahead of production, and it will be necessary to light up some idle stacks.

Birmingham.—Sales for third and fourth quarter are being made, and the market is strengthening. Several furnaces have been put in blast and others are expected to follow shortly. The increase of prices in other districts has had a good effect on the local market.

HEAVY MELTINGS STILL SCARCE

The scrap market shows great strength in both iron and steel scrap. Heavy melting and re-rolling were strong and in some cases cast scrap approaches the price of pig iron.

Philadelphia.—A large tonnage of heavy melting steel has been sold here for Pittsburgh shipment at $23 delivered. Sales generally are light, but prices are advancing on account of activity in other centres. All grades of scrap are scarce.

Boston.—An unusual feature was the sale of a small tonnage for fourth quarter delivery, pointing to the fact that consumers expect higher prices. This lot was sold at $28 delivered, and was of No. 1 machinery grade. Other lots of the same grade brought $26.50 delivered.

New York.—Borings and turnings have advanced slightly in response to a better demand. Sales of heavy melting at $22 are reported, but it is thought only small quantities have been bought at this figure by Pittsburgh users. Heavy melting is quoted $16 to $16.50 f.o.b. New York.

Buffalo.—Dealers are very active and prices firm. No. 1 machinery cast is quoted at $24.50 to $25.50 and No. 1 railroad wrought at $23 to $23.50. Heavy melting is quoted in the local market at $20.

Pittsburgh.—Consumers having covered their requirements for the present, the sales have quieted down somewhat, although prices remain firm. Heavy melting has sold at $22.50 and $23 is being asked. Railroad scrap is bringing higher prices for all grades, iron axles being quoted at $31. Low phosphorus has brought $25.

Cleveland.—Although consumers are not buying much the dealers are keeping the market strong. Prices have advanced in almost all grades. A round tonnage of heavy melting has been sold at $23.

Chicago.—A general advance on all grades of $1, and in some cases more, are the conditions here. Rerolling rails have shown a jump of $3 per ton, a small lot having been sold at $33. Railroad offerings are scarce. No. 1 cast, which sold above the pig iron price, is holding firm.

St. Louis.—The scarcity of scrap and the higher prices prevailing are causing consumers to look for low grade pig iron in preference to paying $28 for scrap. Scrap dealers are holding all grades and very little is offering either from railroads or country.

Birmingham.—The market is still behind, but a better spirit is apparent. Dealers have made some small sales. Quotations on heavy melting are around $15 to $16 but it is being held for $20.

Is Your Heating Plant Ready for the Winter?

While the Weather is Warm is the Time to Prepare for the Cold Time Coming—Cold Rooms in a Factory Are a Cause of Dissatisfaction to All Concerned

By T. H. FENNER, Associate Editor

IN that locality which is popularly supposed to be paved with good intentions, we are led to believe that no trouble is ever experienced with the heating arrangements. It is also an attribute af fallible human nature that once the immediate incentive of the said paving material has disappeared, action is delayed in favor of some more pressing need, till the recurring season brings along the old troubles, and a crop of vain regrets. All of which is merely a way of saying that to avoid six months of misery in the winter, a few days or weeks should be devoted in the summer to a thorough examination of the heating arrangements.

There are few things that lead to more lost time and bitter recriminations than the failure of the heating system to properly function at the required time. Workmen coming in to a cold room first thing in the morning are usually disgruntled for the remainder of the day, and are prone to stand around the shop, with their hands in their pockets, calling down anathema on the engineering department, rather than attempt to forget the temperature by an assiduous attention to the job in hand. In many cases they are not to be blamed, for a man who is engaged on monotonous repetition work, which entails but little bodily activity, is usually supersensitive to uncomfortable shop conditions. Furthermore, the plant superintendent, who has to sit in an office where the temperature is around 50 degrees, is not disposed to kindly feelings towards his chief engineer. The latter may not be entirely to blame, as oftentimes lack of sufficient or competent help has caused him to delay the necessary overhauling until an unusually early cold snap brings down trouble on his prematurely gray head.

A winter season such as we had in Canada in 1918-19 did not strain the capacity of the heating plant over-much, and the early spring, followed by the gloriously warm summer, was likely to dispel all thoughts of heating systems from the minds of the engineering staff, but there have been some chilly mornings and evenings lately which serve as a sharp reminder that our summers are short. If not already done now is the time for a sharp and systematic campaign, started at the exhaust line and carried through the factory.

The Right Time To Do It

The proper time to overhaul the heating system is the early summer, just as soon as one can feel that there is no chance of the system being required again that season. All its most obvious needs are, or should be, fresh in the mind then, and the unpleasant remarks caused by them still rankling in the breast. That main reducing valve, for instance, that requires a new diaphragm, the leaky joints in awkward corners of the basement, the vacuum valves which have ceased to justify their existence, and the countless other small things that have had to be neglected for the time being. Small things in themselves, but what a cause of misery in the aggregate.

Perhaps there has been no lack of heat in the factory, but the heat has only been maintained by the expenditure of a totally disproportionate amount of coal or else there has been both a lack of heat in certain sections, as well as a large coal bill. In the small and compactly arranged factory it may not have been very bad, but in the plant that covers a large area of ground, with the heating done from a central plant, the waste may be enormous.

Two Points to be Considered

There are two things to be taken into account. The heating system itself and the state of the buildings. There is little use in having a perfect heating system if there are ½-inch openings around window frames, door jambs, pipe entrances to buildings. The chief engineer should send his foreman bricklayer or painter or go himself if possible, and make a systematic inspection of the buildings, taking careful notes of all places where the cold winds can find entrance, and then take effectual steps to stop them. A little spring yarn caulked tightly into the spaces between window frame and brick work will work wonders in the way of comfort and saving of fuel. Where roofs are built with lanterns take a good look at the joint of roof and lantern, and see that there is no open space under the flashing, and that the flashing itself is in good repair. Count up the broken panes of glass and order the required quantity immediately so that it can be all replaced before the summer is over. There will be quite enough work to be done on building exteriors to keep a man or two busily engaged all summer, and there is no one more vitally interested in having this work done than the chief engineer. Every bit of cold air that enters a building by unauthorized inlets has to be heated up, and it all requires some of his dearly bought b.t.u.'s. Furthermore, a building that is reasonably tight will retain the heat for the better part of the night, when the main engines are stopped, and makes less demands on the live steam.

Coming to the heating plant itself, there is ample scope for useful work to be done. In a large factory there are miles of coils, thousands of feet of main feeders, risers and returns, and hundreds of steam and thermostatic valves, outside of the engine room altogether. The majority of plants using exhaust steam for heating are equipped with a vacuum return system, the returns being delivered to the feed water heater, and thence to the boiler. Where feed water has to be paid for, the more water that is reclaimed from the heating system the less has to be paid for. But it must be free from oil, and it is also necessary to have the oil extracted from the exhaust before it enters the steam heating system, otherwise it will coat the coils and form an excellent non-conductor. Therefore, the oil extractor on the main exhaust line should be thoroughly cleaned, and the trap or other drainage arrangements examined and put in good shape. The vacuum pump should next be overhauled, both steam and water ends, and rods turned up if necessary. The suction and discharge valve plates should be taken out, and if the valve seats are worn unevenly, they can be put on the shaper and faced up. Failing this, they should be faced up with a surface board and file and scraper. Overhaul the valve springs and valves, pack the plunger, and see that the pump barrel liner is not worn in the middle. If it is have it bored out. Once the pump is as perfect as possible you are in a position to start testing out your system. The usual arrangement of piping is a main carried from power house to factory basement, and individual branches carried to different sections of the building. The return branches are brought back to a return main, which is connected to the suction of the vacuum pump. The function of the vacuum pump is two-fold. It has to deliver the condensation from the returns to the feed heater, and also maintain a difference of pressure between the main exhaust and the return system, to ensure a circulation of steam through all the coils. If the pump is not doing its duty, there will be an increase of back pressure on the engine, and the heating system will be filled with water, the result being more fuel consumed, and a cold factory, while the heat that should be going into the building will be carried up the atmospheric exhaust to the open air. If there are leaks in the system anywhere the pump will be drawing air into the returns instead of maintaining a vacuum. Air leaks should be eliminated as far as practicable. Now shut off every branch valve, both steam and return, leaving only the length of the main return open

Continued on page 196

SELECTED MARKET QUOTATIONS

Being a record of prices current on raw and finished material entering into the manufacture of mechanical and general engineering products.

PIG IRON

Grey forge, Pittsburgh	$27 15
Lake Superior, charcoal, Chicago	34 60
Standard low phos., Philadelphia	....
Bessemer, Pittsburgh	29 35
Basic, Valley furnace	25 75
Toronto price:—	
Silicon..2.25% to 2.75%	$32.75 to $35.75

IRON AND STEEL

Per lb. to Large Buyers	Cents
Iron bars, base, Toronto	$ 4 25
Steel bars, base, Toronto	4 25
Steel bars, 2 in. to 4 in. base	5 50
Steel bars, 4 in. and larger base	6 00
Iron bas, base, Montreal	3 75
Steel bars, base, Montreal	3 75
Reinforcing bars, base	4 50
Steel hoops	5 50
Norway iron	11 00
Tire steel	5 50
Spring steel	8 00
Brand steel, No. 10 gauge, base	4 40
Chequered floor plate, 3-16 in.	6 50
Chequered floor plate, ¼ in.	6 25
Staybolt iron	8 00
Bessemer rails, heavy, at mill	....
Steel bars, Pittsburgh	2 35
Tank plates, Pittsburgh	2 65
Structural shapes, Pittsburgh	2 45
Steel hoops, Pittsburgh	3 05
F.O.B., Toronto Warehouse	
Small shapes	4 50
F.O.B. Chicago Warehouse	
Steel bars	3 62
Structural shapes	3 72
Plates	3 90
Small shapes under 3"	3 62

FREIGHT RATES

	Per 100 lbs. C.L.	L.C.L.
Pittsburgh to Following Points		
Montreal	33	45
St. John, N.B.	41½	55
Halifax	49	64½
Toronto	27	39
Guelph	27	39
London	27	39
Windsor	27	39
Winnipeg	89½	135

METALS

	Gross	
Lake copper	$27 00	$27 00
Electro copper	26 00	27 00
Castings, copper	26 00	25 00
Tin	57 00	58 00
Spelter	10 00	10 00
Lead	7 25	7 00
Antimony	10 50	10 50
Aluminum	36 00	35 00

Prices per 100 lbs.

PLATES

	Montreal	Toronto
Plates, ½ up	$ 4 50	$ 4 50
Plates, 3-16 in.	4 90	4 90

Price List No. 38

WROUGHT PIPES

Standard Buttweld

	Per 100 feet	
⅛ in.	$ 6 00	$ 8 00
¼ in.	4 68	6 81
⅜ in.	4 68	6 81
½ in.	6 21	7 78
¾ in.	7 82	9 95
1 in.	11 56	14 71
1¼ in.	15 64	19 90
1½ in.	18 70	23 76
2 in.	25 16	32 01
2½ in.	40 37	51 19
3 in.	52 79	66 94
3½ in.	67 16	84 18
4 in.	79 57	99 74

Standard Lapweld

2 in.	38 81	35 34
2½ in.	42 12	52 36
3 in.	55 08	68 47
3½ in.	69 00	86 94
4 in.	81 75	103 00
4½ in.	93	1 18
5 in.	1 08	1 37
6 in.	1 40	1 78
7 in.	1 83	2 32
8L in.	1 93	2 44
8 in.	2 22	2 81
9 in.	2 66	3 36
10L in.	2 46	3 12
10 in.	3 17	4 02

Terms 2% 30 days, approved credit.

Freight equalized on Chatham, Guelph, Hamilton, London, Montreal, Toronto, Welland.

Prices—Ontario, Quebec and Maritime Provinces.

WROUGHT NIPPLES

4" and under, 60%.
4½" and larger 50%.
4" and under, running thread, 30%.
Standard couplings, 4" and under, 40%, 4½" and larger, 20%.

OLD MATERIAL

Dealers' Buying Prices.

	Per 100 Pounds Montreal	Toronto
Copper, light	$17 00	$13 75
Copper, crucible	21 50	18 00
Copper, heavy	21 50	18 00
Copper wire	21 50	18 00
No. 1 machine composition	18 00	16 75
New brass cuttings	13 00	10 75
Red brass cuttings	16 00	14 75
Yellow brass turnings	10 00	9 00
Light brass	9 00	7 00
Medium brass	10 00	7 75
Scrap zinc	6 50	6 00
Heavy lead	5 00	5 25
Tea lead	4 00	3 50
Aluminum	18 00	18 00
	Per Ton.	Net
Heavy melting steel	14 00	13 50
Shell turnings	7 00	6 00
Boiler plate	14 00	11 00
Axles (wrought iron)	20 00	20 00
Rails	20 00	13 50
Malleable scrap	16 00	17 00
No. 1 machine cast iron	20 00	18 00
Pipe wrought	11 00	5 00
Car wheels	20 00	20 00
Steel axles	20 00	20 00
Mach. shop turnings	6 00	6 00
Stove plate	15 00	13 00
Cast boring	5 50	8 00

BOLTS, NUTS AND SCREWS

	Per Cent.
Carriage bolts, ⅜" and less	35
Carriage bolts, 7-16 and up	15
Coach and lag screws	50
Stove bolts	65
Wrought washers	50
Elevator bolts	25
Machine bolts, 7-16 and over	40
Machine bolts, ⅜ and less	40
Blank bolts	25
Bolt ends	25
Machine screws, fl. and rd. hd., steel	27½
Machine screws, o. and fil. hd., steel	10
Machine screws, fl. and rd. hd., brass	net
Machine screws, o. and fil. hd brass	net
Nuts, square blank	add $0 75
Nuts, square, tapped	add 1 00
Nuts, hex., blank	add 1 00
Nuts, hex., tapped	add 1 25
Copper rivets and burrs, list less	15
Burrs only, list plus	25
Iron rivets and burrs	40 and 5
Boiler rivets, base ¾" and larger	$8 50
Structural rivets, as above	8 40
Wood screws, O. & R., bright	75
Wood screws, flat, bright	77½
Wood screws, flat, brass	55
Wood screws, O. & R., brass	55½
Wood screws, flat, bronze	50
Wood screws, O. & R., bronze	47½

MILLED PRODUCTS

(Prices on unbroken packages)

Set screws	50
Sq. and Hex. Head Cap Screws	45
Rd. and Fil. Head Cap Screws	20
Flat But. Hd. Cap Screws	10
Fin. and emi-fin. nuts up to 1 in.	45
Fin. and Semi-fin. nuts, over 1 in., up to 1½ in.	40
Fin. and Semi-fin. nuts over 1½ in., up to 2 in.	25
Studs	30
Taper pins	50
Coupling bolts,	10
Planer head bolts, without fillet, list	10
Planer head bolts, with fillet, list plus 10 and	net
Planer head bolt nuts, same as finished nuts.	
Planer bolt washers	net
Hollow set screws	net
Collar screws	list plus 20, 30
Thumb screws	40
Thumb nuts	75
Patch bolts	add 20
Cold pressed nuts to 1½ in.	add $1 00
Cold pressed nuts over 1½ in.	add 2 00

BILLETS

	Per gross ton
Bessemer billets	$38 50
Open-hearth billets	38 50
O.H. sheet bars	42 00
Forging billets	51 00
Wire rods	52 00

Government prices.
F.O.B. Pittsburgh.

NAILS AND SPIKES

Wire nails	$4 70
Cut nails	4 75
Miscellaneous wire nails	60%
Spikes, ⅜ in. and larger	$7 50
Spikes, ¼ and 5-16 in.	8 00

ROPE AND PACKINGS

Drilling cables, Manila	0 39
Plumbers' oakum, per lb.	0 10
Packing, square braided	0 38
Packing, No. 1 Italian	0 44
Packing, No. 2 Italian	0 36
Pure Manila rope	0 37
British Manila rope	0 31
New Zealand hemp	0 31
Transmission rope, Manila	0 43
Cotton rope, ¼-lb. and up	0 74

POLISHED DRILL ROD

Discount off list, Montreal and Toronto	net

MISCELLANEOUS

Solder, strictly	$ 0 34
Solder, guaranteed	0 39
Babbitt metals	18 to 70
Soldering coppers, lb.	0 58
Lead wool, per lb.	0 14
Putty, 100-lb. drums	6 75
White lead, pure, cwt.	17 80
Red dry lead, 100-lb. kegs, per cwt.	15 50
Glue, English	0 35
Tarred slater's paper, roll	1 30
Gasoline, per gal., bulk	0 33
Benzine, per gal., bulk	0 32
Pure turpentine, single bbls., gal.	1 50
Linseed oil, raw, single bbls.	2 90
Linseed oil, boiled, single bbls.	2 92
Plaster Paris, per bbl.	4 50
Sandpaper, B. & A.	List plus 43
Emery cloth	List plus 37½
Sal Soda	0 03½
Sulphur, rolls	0 05
Sulphur, commercial	0 04½
Rosin "D," per lb.	0 07
Rosin "G," per lb.	0 08
Borax crystal and granular	0 14
Wood alcohol, per gallon	2 00
Whiting, plain, per 100 lbs.	2 50

CARBON DRILLS AND REAMERS

S.S. drills, wire sizes up to 52	40
S.S. drills, wire sizes, No. 53 to 80	50
Standard drills, all sizes	50
3-fluted drills, plus	10
Jobbers' and letter sizes	50
Bit stock	40
Ratchet drills	15
S.S. drills for wood	40
Wood boring brace drills	25
Electricians' bits	30
Sockets	50
Sleeves	50
Taper pin reamers	net
Drills and countersinks	list plus 10
Bridge reamers	50
Centre reamers	10
Chucking reamers	net
Hand reamers	10
High speed drills, list plus	10 to 40
Canadian high speed cutters	net
American	plus 40

COLD ROLLED SHAFTING

At mill	list plus 5%
At warehouse	list plus 25%

Discounts off new list. Warehouse price at Montreal and Toronto

IRON PIPE FITTINGS

Malleable fittings, class A, 20% on list; class B and C, net list. Cast iron fittings, 15% off list. Malleable bushings, 25 and 7½%; cast bushings, 25%; unions, 45%; plugs, 20% off list. Net prices malleable fittings; class B black, 24½c lb.; class C black, 15¾c lb.; galvanized, class B, 34c lb.; class C, 24½c lb. F.O.B. Toronto.

SHEETS

	Montreal	Toronto
Sheets, black, No. 28	$ 6 55	$ 6 00
Sheets, black, No. 10	5 15	5 45
Canada plates, dull, 52 sheets	8 50	7 10
Can. plates, all bright.	8 50	8 00
Apollo brand, 10¾ oz. galvanized	.....	.....
Queen's Head, 28 B.W.G.	.....	.....
Fleur-de-Lis, 28 B.W.G.	.....	.....
Gorbal's Best, No. 28	.....	.....
Colborne Crown, No. 28	.....	.....
Premier, No. 28 U.S.	.....	7 50
Premier, 10¾ oz.	.....	7 80
Zinc sheets	20 00	20 00

PROOF COIL CHAIN

(Warehouse Price)

B

¼ in., $13.50; 5-16, $11.50; ⅜ in., $10.50; 7-16 in., $9.30; ½ in., $10.15; $13.00; ⅞ in., $9.60; ¾ in., $9.70; ⅝ in., $9.95; 1 in., $9.50; Extra for B.B. Chain, $1.20; Extra for B.B.B. Chain, $1.80.

ELECTRIC WELD COIL CHAIN B.B.

⅛ in., $16.75; 3-16 in., $15.40; ¼ in., $14.20; 5-16 in., $11.50; ⅜ in., $10.50; 7-16 in., $9.30; ½ in., $10.50; ⅝ in., $10.00; ¾ in., $9.70.

Prices per 100 lbs.

FILES AND RASPS

	Per Cent.
Globe	50
Vulcan	50
P.H. and Imperial	50
Nicholson	32½
Black Diamond	27½
J. Barton Smith, Eagle	50
McClelland, Globe	50
Delta Files	20
Disston	40
Whitman & Barnes	50
Great Western-American	50
Kearney & Foot, Arcade	50

BOILER TUBES.

Size.	Seamless	Lapwelded
1 in.	$25 00	$.....
1¼ in.	27 00	.....
1½ in.	28 00	26 00
1¾ in.	30 00	26 00
2 in.	30 00	26 00
2¼ in.	33 00	28 00
2½ in.	40 00	32 00
3 in.	46 00	38 00
3¼ in.	.....	45 00
3½ in.	56 00	42 00
4 in.	70 00	54 00

Prices per 100 ft., Montreal and Toronto

OILS AND COMPOUNDS.

Castor oil, per lb.	.....
Royalite, per gal., bulk	19½
Palacine	22½
Machine oil, per gal.	27½
Black oil, per gal.	16
Cylinder oil, Capital	52
Cylinder oil, Acme	39½
Standard cutting compound, per lb.	0 06
Lard oil, per gal.	$2 60
Union thread cutting oil, antiseptic	88
Acme cutting oil, antiseptic	37½
Imperial quenching oil	39½
Petroleum fuel oil, bbls. net	10¼

BELTING—No 1 OAK TANNED

Extra heavy, single and double	30%
Standard	30, 10%
Cut leather lacing, No. 1	2 20
Leather in sides	1 75

TAPES

Chesterman Metallic, 50 ft.	$2 00
Lufkin Metallic, 603, 50 ft.	2 00
Admiral Steel Tape, 50 ft.	2 75
Admiral Steel Tape, 100 ft.	4 45
Major Jun. Steel Tape, 50 ft.	3 50
Rival Steel Tape, 50 ft.	2 75
Rival Steel Tape, 100 ft.	4 45
Reliable Jun. Steel Tape, 50 ft.	3 50

PLATING SUPPLIES

Polishing wheels, felt	3 25
Polishing wheels, bull-neck	2 00
Emery in kegs, American	07
Pumice, ground	3½ to 05
Emery glue	28 to 30
Tripoli composition	06 to 09
Crocus composition	08 to 10
Emery composition	08 to 09
Rouge, silver	35 to 50
Rouge, powder	30 to 45

Prices per lb.

ARTIFICIAL CORUNDUM

Grits, 6 to 70 inclusive	.08½
Grits, 80 and finer	.06

BRASS—Warehouse Price

Brass rods, base ½ in. to 1 in. rod	0 34
Brass sheets, 24 gauge and heavier, base	$0 42
Brass tubing, seamless	0 46
Copper tubing, seamless	0 48

WASTE

XXX Extra	19½	Atlas	17
Peerless	19	X Empire	15½
Grand	18	Ideal	16
Superior	18	X Press	14
X L C R	17		

Colored

Lion	15	Popular	12
Standard	13½	Keen	10½
No. 1	13½		

Wool Packing

Arrow	25	Anvil	15
Axle	20	Anchor	11

Washed Wipers

Select White	11	Dark colored	09
Mixed colored	10		

This list subject to trade discount for quantity.

RUBBER BELTING

Standard ... 10% Best grades... 15%

ANODES

Nickel	.58 to .65
Copper	.38 to .45
Tin	.70 to .70
Zinc	.18 to .18

Prices per lb.

COPPER PRODUCTS.

	Montreal	Toronto
Bars, ½ to 2 in.	$42 50	$43 00
Copper wire, list plus 10		
Plain sheets, 14 oz., 14x60 in.	46 00	44 00
Copper sheet, tinned, 14x60, 14 oz.	48 00	48 00
Copper sheet, planished, 16 oz. base	46 00	45 00
Braziers', in sheets, 6 x 4 base	45 00	44 00

LEAD SHEETS.

	Montreal	Toronto
Sheets, 3 lbs. sq. ft.	$10 25	$11 50
Sheets, 3½ lbs. sq. ft.	10 00	11 00
Sheets, 4 to 6 lbs. sq. ft.	9 75	10 50

Cut sheets, ½c per lb. extra.
Cut sheets to size, 1c per lb. extra.

PLATING CHEMICALS.

Acid, boracic	$ .25
Acid, hydrochloric	.06
Acid, nitric	.14
Acid, sulphuric	.06
Ammonia, aqua	.15
Ammonium carbonate	...
Ammonium, chloride	.55
Ammonium hydrosulphuret	.30
Ammonium sulphate	.15
Arsenic, white	.27
Copper, carbonate, annhy	.50
Copper, sulphate	.22
Cobalt, sulphate	.20
Iron perchloride	.40
Lead acetate	.25
Nickel ammonium sulphate	.25
Nickel carbonate	.32
Nickel sulphate	.35
Potassium carbonate	.75
Potassium sulphide (substitute)	2 25
Silver chloride (per oz.)	1.45
Silver nitrate (per oz.)	1.20
Sodium bisulphite	.15
Sodium carbonate crystals	.05
Sodium cyanide, 127-130%	.40
Sodium hydrate	.22
Sodium hyposulphite, per 100 lbs.	6.00
Sodium phosphate	.18
Tin chloride	.80
Zinc chloride, C.P.	.80
Zinc sulphate	.15

Prices per lb. unless otherwise stated.

IS YOUR HEATING PLANT READY?

(Continued from page 193)

to the pump. Better still blank off the return branches in case there may be leaky valves on the branch where it joins the main. Blank off the water connection to the small condenser on the suction pipe and start the pump. You should get a vacuum immediately, and if your pump is in good shape you will be able to drain from 20 to 24 inches on the gauge. Now stop the pump, and if the length you are testing is tight, the vacuum will be maintained for a considerable time, say 10 to 15 minutes. If it disappears in three or four minutes there is a leak, which must be stopped. Now take the blank flange from one branch and connect it to the return main. This branch may carry four or more coils. Blank these coils off at the steam end, one at a time, and take the thermostatic valve out of the return end, and get the vacuum again. If it does not hold, take a candle, keeping the pump running, and try the flame at every joint till the leak is discovered. Try every coil in this way, till you are morally certain that your return system is airtight.

Then comes the steam side. You can test this out by taking out the thermostatic valves and pulling the vacuum right through, but a more convenient way is to blank your main, one section at a time, and attach a small branch from the air compressor to it. Pump up about five pounds pressure, and see how long it remains. You will soon discover the leak and can remedy each section as you go along. There remains one very important feature, the thermostatic valves. There are various types of these, some being controlled by the expansion and contraction of a volatile liquid and others by the expansion and contraction of a carbon. Those operated by the liquid usually are non-adjustable, but the carbon ones are, and if not adjusted correctly will allow steam to blow right through the coil. Now the latent heat of steam is much more than the sensible heat, but if the steam is not held in the coil till condensed, the latent heat will be given out where it is not wanted, in the return pipe. Therefore, the thermostatic valve must be adjusted so that it will remain closed unless surrounded by water. The best way to ensure this is to disconnect the union on the return side of the valve and then put steam in the coil. If steam blows through screw the carbon body down a little by the screw provided in the top, until the steam stops. Then note if it opens to let the condensation out. It should open and shut precisely as a steam trap does.

When the system is in operation send a man around to every coil at least once a week, to see that valve spindles are tight and nothing leaking on the coil itself.

These precautions will well repay the work involved by the peace and comfort obtained. A factory uniformly warm in every department, Monday morning as well as Saturday noon, will produce more and better work than one in which these conditions are not maintained.

A NEW RUDDER

A rudder of a completely novel type, which has been used on small vessels during the war, is about to be developed commercially. It is named after its inventor, Mr. J. G. A. Kitchen of Lancaster. It enables a boat to be steered, reversed, controlled and turned by a single tiller, and with the engines running continuously in the forward direction. The rudder consists of two parts which, when closed form a cone, apex pointing aft; and, when fully open, form a sort of tunnel in the wake of the screw. Whether shut or open the rudder as a whole can be turned to port or starboard like one of the ordinary kind. When the rudder is closed the propeller stream entering the open mouth is deflected forwards by the sides of the cone, brings the vessel to rest, and then moves it astern. The partial opening of the plates allows some water to pass through, and the speed and direction of the boat can thus be controlled without slowing the engines. For ordinary steering the rudder is opened fully, and deflects the propeller stream to one side or the other. It has an extremely powerful braking effect, and is capable of arresting a vessel in its own length; while its capacity for deflecting the water driven aft by the propeller renders it very useful for manoeuvring in restricted places.

Electric Furnaces in the Iron and Steel Industry; Rodenhauser, Schoenawa and Vom Baur. John Wiley & Sons, Inc., New York.

This is the second English edition of this well-known work. In it a number of changes and additional matter have been incorporated consequent upon the rapid growth of the electric furnace industry. While a considerable number of books has been written on the subject of the electric furnace, the majority of them are of such general scope that the iron and steel industry does not receive the attention it warrants. An historical resume of the development of this branch is given and is followed by a chapter devoted to the explaining of the laws and principles of electricity which enter into electric furnace work. This chapter is somewhat elementary in its scope and has been inserted for the benefit of the general student interested in this branch of metallurgy. The effects of the electric current in the production of heat by resistance, arc or induction heating is dealt with next, together with other actions of the electric current in the furnace, such as the motor and pinch effects. Chapters IV, V and VI deal with power factor and alternating current theory in general, general conditions for the operation of electric furnaces and arc furnaces in general. The various types of arc furnace dealt with are the Stassano, now practically obsolete, the Heroult, the Girod and the Pennerfelt. Induction furnaces, now little used, are also treated of. Space is given to the electric shaft furnace for the reduction of iron ore. Part II takes up materials for furnace construction and the costs of operation, and Part III, the electro-metallurgy of iron and steel. These latter two parts of this book are of value from the economic standpoint, as an exhaustive treatment is given of everything affecting the operation and economics of the electric furnace.

Next time you "light up," think of this:

About 10,000 matches are scratched in this country every second that passes, and of these 95 per cent. are used by smokers to fire pipe, cigar, or cigarette.

The man whose head for figures turned out that information also estimates that the time lost by the smokers in lighting matches—not in smoking—is worth $513,024 each eight-hour working day.

He arrives at his estimate by figuring that it takes fifteen seconds to scratch a match and use the light, and that 213,759 men, whose time is worth thirty cents an hour, are holding matches at the same time, thus losing golden minutes at the rate of $1,068 a minute, or $64,128 an hour.

No one, so far as we can learn, has figured out how large a percentage of the match-scratchers throw away the matches while they are still burning, but it has been estimated that half of the fires which cost the United States $250,000,000 a year are caused by carelessness.

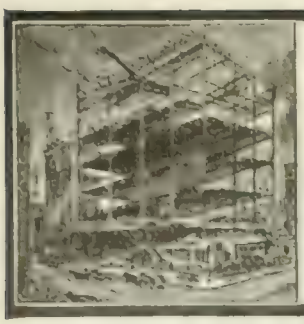
Wood, phosphorus, chlorate of potash, rosin, whiting, and powdered flint are the makings of this little device.

In some anti-aircraft shells use is made of the bow wave of compressed air which is present on projectiles travelling at a sufficient velocity. In flight the striker of the fuse rides or floats on this bow wave and absolutely nothing else keeps it off the primer. The instant an obstruction, no matter how light, is encountered, the wave disappears and the striker jambs back on the primer, exploding the shell. These fuses will explode on your silk handkerchief not to mention airplane and balloon fabrics.

The discovery of helium in natural gas, both in Canada and the United States, has brought the price of this element down from over $1,000 a cubic foot to a merely nominal figure and has rendered it possible to use it for the inflation of balloons.

Accidents in the iron and steel industry have decreased by more than two-thirds during the past ten years as a result of the movement to enforce safety regulations.

The motor cycle has found use in a Hawaiian sugar factory as a heavy hauling unit or baby tractor. Four and a half tons can be hauled distributed over four cars.



INDUSTRIAL NEWS

NEW SHOPS, TENDERS AND CONTRACTS PERSONAL AND TRADE NOTES

TRADE GOSSIP

Building Foundry. — Burnett and Crampton, Rigaud, Que., are planning a new foundry capable of turning out 250 tons of castings a month. They will install molding machines and equipment of the most modern type for producing machinery castings, mill and mining equipment and general castings.

Sault Ste. Marie.—Freight through the Soo canals shows a decrease from that in July, 1918, of 1,446,192 tons. The amount carried this July was 11,916,152. Two-thirds of this tonnage was going eastward. Of the total tonnage only 533,377 was carried through the Canadian canals.

Lachine Canal Reports.—The gross tonnage passing through the canal for July and for the season to the end of July is less than for the corresponding period of last year. A larger tonnage of grain has been moved, but the coal shipment has decreased. For the three months ending July 31 the grain carried was 10,414,989 bushels, and for the month of July 2,017,134 bushels. The coal tonnage was 36,313 tons less this July than last.

Privy Council Lowers Award.—The case between the Seattle Construction & Dry Dock Co., and the firm of Grant, Smith & Co., arising out of the loss of a drydock has been settled finally by the Privy Council. The Drydock Co. had been previously awarded $85,000 by Justice Clement and the board of assessors in the Vancouver Court. The Privy Council reduced the award to $44,500. The claim was for $150,000. The dock was wrecked when the contractors, Grant, Smith & Co., attempted to utilize it in the placing of large concrete caissons in Victoria Harbor.

Squaring Up With the U.S.—Great Britain has liquefied her munition debt to the U. S. by a payment of $35,176,123. Of this sum $13,600,000 was for Liberty motors, $13,274,000 for airplane spruce, $2,887,000 for wood distillates, $4,690,000 for powder, and $651,000 for cotton lineters.

Do Not Favor Kitsilano. — Public opinion in Vancouver is against the use of Kitsilano as a site for the terminals of the Canadian National Railways. Burrard Inlet is regarded as being eminently more suitable, and it is believed that the Government also takes this view as they are building the approaches to Burrard Inlet. A site at Kitsilano would involve the city in a large outlay for new bridges, besides spoiling this district as a pleasure resort, which is now its most valuable feature.

Going After Trade.—The B. C. and Overseas Trading Company, which was formed recently with "Expand B. C. Industries" as a slogan, is going after trade in the Orient. Mr. J. Fred Sanders, the president, has gone to China to study the needs of the market there and will send back instructions to the firm concerning the goods required, methods of packing, weights, measurement and style to conform with the customer's wishes.

To Get Canadian Goods.—Mr. Marcus Reich, of Prague, who represents the Importers' Association of Czecho Slovakia, is in Toronto to confer with the Trades Commissioner and the Canadian Manufacturers' Association. He desires to establish banking facilities and promises the establishment of a Canadian Chamber of Commerce in Prague. His country manufactures cotton goods and porcelain extensively, but require raw material and other manufactured goods.

Lumbermen Criticized—Sir Douglas Colin Cameron, Lieut.-Col. and Lieut. Governor of Manitoba, who is also president of the Rat Portage Lumber Co., as well as being connected with other large interests through Canada, had some words of criticism for the lumbermen of B.C., on the occasion of a visit to Vancouver recently. "There are great markets for B. C. lumber," he said, "but the lumbermen have not availed themselves of their opportunities. It creates an unfavorable impression to find that the 70,000,000 feet order of lumber placed here has not yet been moved.

Valuing Fraser River Yard.—An arbitration board has been sitting in the Vancouver Court House to determine the value of the plant of the Imperial Munitions Board in the Poplar Island yard of the New Westminster Shipbuilding Co. The public sittings have been concluded but the award has not yet been given out. During the proceedings the contract between the Imperial Munitions Board and the New Westminster Co. was produced. The agreement was that the company should be reimbursed for the actual cost of building each hull, and receive a sum of $16,000 profit on each. The board consists of Mr. Justice Morrison, Mayor Gray of New Westminster, and Arthur H. Edwards.

Victoria Yards Please New York.—The success of the Foundation Company's yards at Victoria, has attracted favorable notice at the head office of the organization in New York, according to Frank Quilter, secretary-treasurer of the company. The good performances of the Victoria built ships on their trial trips has been the subject of much favorable comment. The Foundation Company are now at the height of their activity in Victoria, and the payroll amounts to over $500,000 per month.

One Engine Per Day.—The works of the Kerr & Goodwin Machine Company at Brantford, are now turning out one of the new Hoag oil engines manufactured by this company every day. There is good prospect of these engines being made on a large scale very shortly.

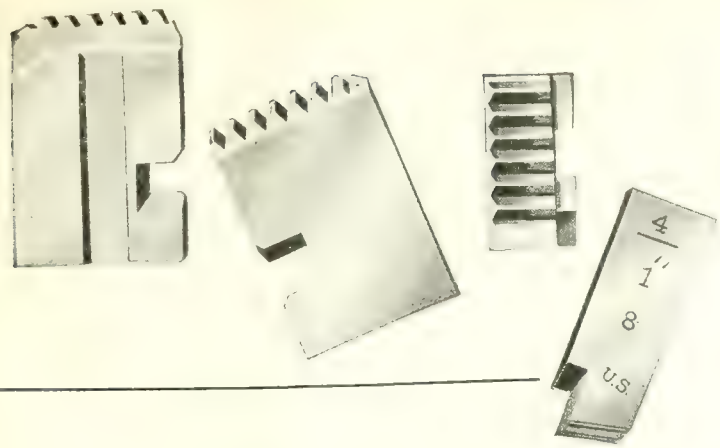
New Steel Mill.—A proposition to build a large steel plant in Belleville is now under consideration by the Tivani Steel Co., Ltd. The plant would consist of electric furnaces, rolling mills, merchant bar mills and open-hearth furnaces. A similar plant is being considered for Vancouver.

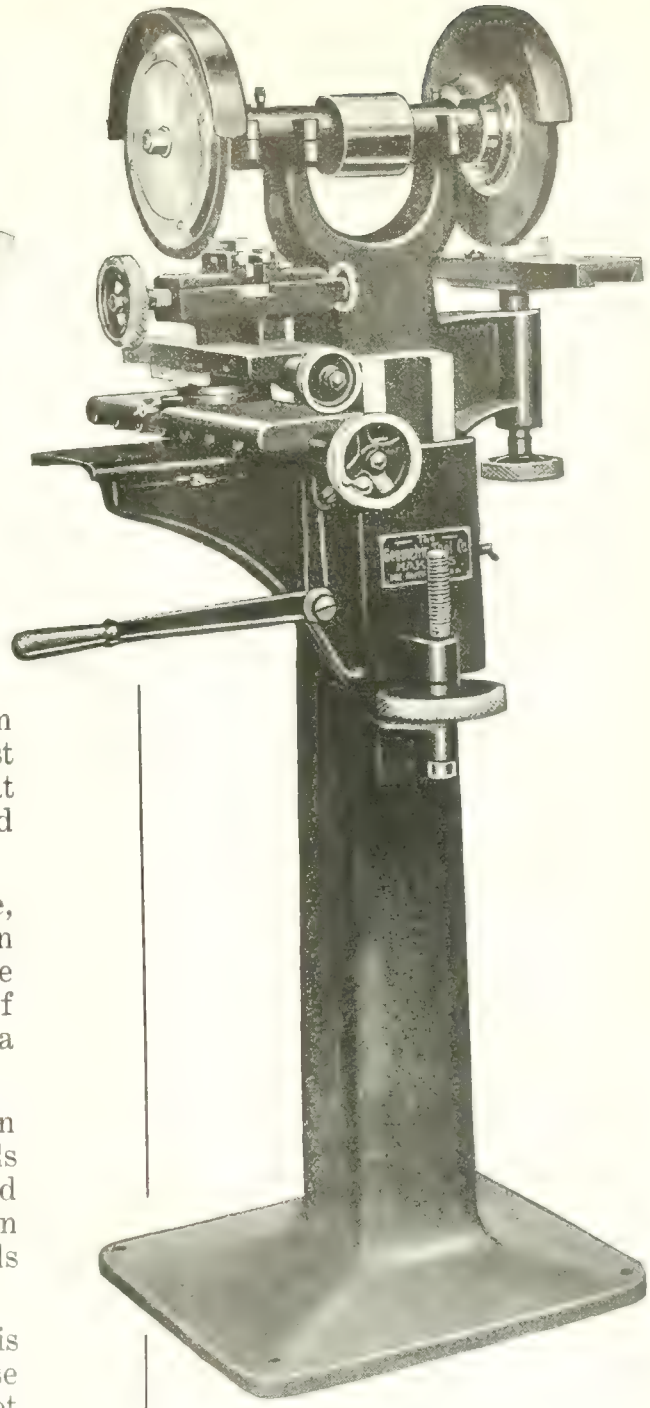
Tin Plant.—Galt is to be the site of a tin smelting plant, for which we understand a contract has been let. The idea is to build one smelter to begin with to be followed by others as the need arises.

MARINE

Halifax.—The steamer "Troja," which was recently salvaged at the entrance of the Bay of Fundy by the Maritime Wrecking Company of Halifax, has been brought to Halifax in a pretty bad condition. The repairs will be given to the firm making the most successful tender, and it is thought here that the job will go to the Halifax Shipyards Ltd., who are operating the dry dock.

Montreal.—The monthly service to be provided between Montreal and Havre, France, by the Cie Canadienne-Francaise Transatlantique was inaugurated by the arrival of the steamer "Californie" in Montreal. She brought over 280 passengers, of whom 265 landed at Quebec. The vessel left again for Havre on the 7th inst. with freight and passengers.





Sharp Chasers Cut Clean Threads

Accurate, uniform threads result only from dies which are maintained in the highest state of cutting efficiency. This means that chasers must be kept sharp, and ground uniformly.

Even if just touched up from time to time, the chasers respond splendidly, with clean threads. And with this machine — the Geometric Chaser Grinder—the matter of keeping threading tools up to scratch is a comparatively simple matter.

Various makes of chasers can be ground on this adaptable machine. The two wheels permit the easy grinding of both milled and tapped chasers. In addition, the plain wheel lends itself readily to various kinds of tool grinding.

Uniform grinding of a set of chasers is purely a mechanical matter through the use of adjustments which can be accurately set to govern the grinding of an entire set of chasers.

The Catalog describing this machine is a mine of information on chaser grinding. Write for it.

THE GEOMETRIC TOOL COMPANY

NEW HAVEN CONNECTICUT

Canadian Agents:

Williams & Wilson, Ltd., Montreal. The A. R. Williams Machinery Co., Toronto, Winnipeg, St. John, N. B.

The second steamer, the "Hudson," is expected shortly.

Victoria.—The Canadian Pacific Railway Co. are building two new steamers for the Pacific service of 20,000 tons each. One has already been launched in England and will be called the "Empress of Canada," while the second one, which has just been laid down, will be named the "Empress of Australia."

North Vancouver.—After the launching of the C 39, the last of the eight ships built for the French Government from the Lyall yards, a number of the men were laid off. There are now only about 300 men employed in fitting out the vessels already launched. The yards at one time employed 1,200 men.

Cleveland.—A large number of freighters are being held idle owing to the strike of ore dock workers at Superior. A number of vessels have loaded coal and are holding it until owners are sure that there will be no delays in unloading at Lake Erie ports.

Buffalo.—There are six freighters on the way to Buffalo with approximately 1,500,000 bushels of grain aboard them. By the first week in September the full movement of grain will be under way. Shipments of ore are increasing and hopes are entertained of a good season despite the slow start.

PERSONALS

Sergeant Paul Mitchell, of the Provisional Supply Depot, American Expeditionary Forces, France, has just returned to Chicago and has resumed his duties as travelling representative for the Independent Pneumatic Tool Company, 600 W. Jackson Blvd., manufacturers of Thor air and electric tools. Mr. Mitchell will travel out of the Chicago sales office as heretofore.

TENDERS

The Peterborough Board of Education are asking for tenders on a new school. Tenders received till September 1. Plans and specifications can be obtained at the office of the architect, W. & W. R. L. Blackwell, Room 17, Bank of Commerce Building, Peterborough.

The Toronto Board of Education are asking tenders for an addition to Keele Street School. Tenders open till August 27. Specifications and information can be obtained at the office of Messrs. Chapman & Oxley, Harbor Commission Building, Toronto.

The Norton Co. and Norton Grinding Co. have arranged to conduct their business through the Norton Co., starting July 1. A board of directors has been appointed and several other important appointments have been made in this new organization of the two companies.

The Electric Furnace Co., Alliance, Ohio, has just shipped to the Dayton Engineering Laboratories, Dayton, Ohio, an electric furnace for melting and refining aluminum in the Delco plant. This furnace has a hearth capacity of 500 pounds, and a melting rate of 200 pounds of aluminum per hour. It is equipped with a double charging door in the front and rear, and otherwise is similar to the standard Baily electric furnace of 105 k.w. electrical capacity, and 1,500 pounds hearth capacity, that is used for melting brass.

The growth of trades unionism in Canada is shown by the following table: 1911, 133,132; 1912, 160,120; 1913, 175,799; 1914, 166,163; 1915, 143,343; 1916, 160,407; 1917, 204,630; 1918, 248,887.

Heating Buildings With Electricity. There has been considerable experimenting in certain parts of the Pacific-Northwest states, where there is ample hydro electric development, with heating dwellings and office buildings with electricity, both as an adjunct to steam heat, and with electricity alone. One investigator, after considerable research, found that to compete with steam heat it would be necessary to deliver electricity to the premises to be heated at from $1.95 to $3.73 per hp.-year. With electricity at one-half cent per kw.-hr., electricity for heating is from 25 to 50 per cent. more expensive than for coal at $6.00 per ton. At one cent per kw.-hr. electricity is two and one-half to three times as costly.

ELECTRIC BRASS FURNACES DISPLACE OTHER TYPES

One Company Uses 2,500 Kw. for Melting in Three-Phase Furnaces, Another Requires 800 Kw. for One-Phase Induction Furnaces

Brass manufacturers who recently met in the convention of iron and steel electrical engineers at Pittsburgh said that they knew from experience that there are now electric brass furnaces whose metallurgical efficiency justifies their use in preference to fuel-fired furnaces. W. R. Clark, works manager of the Bridgeport (Conn.) Brass Company, spoke on the experience of his company, which has in operation a total of 800 kw. in the Ajax Metal Company's "Wyatt" single-phase, 60-cycle induction furnaces melting brass. He said that the largest furnace has a demand of 75 kw. at 75 per cent. power factor, and its pouring capacity is from 500 lb. to 600 lb. (340 kg. to 290 kg.) per hour. These furnaces have melted and poured from 6 lb. to 9 lb. (2.7 kg. to 4.1 kg.) of brass per kilowatt hour, and the linings are being used for as many as 2,000 heats each. A 75-kw. rating is not the largest for which this type of furnace can be built, but when designed for 60-cycle operation the power factor drops rapidly with increased size. The induction furnace is found to have the advantage of heating the bath from within, automatically stirs the molten metal and has very little tendency to give off spelter. However, the furnace is limited in size and has the disadvantage that it must be started with molten metal from another furnace. This latter characteristic is more of a drawback in a foundry than in a brass mill.

This Bridgeport (Conn.) Brass Company is increasing its electric melting capacity by the addition of a 1-ton (900 kg.) "Detroit" rocking type brass furnace which has opposed arcs from electrodes entering through the centre of an oscillating drum. The voltage across the arc is 65 and the maximum demand is from 250 kw. to 300 kw. per ton. This furnace is expected to melt a ton of brass with from 225 kw. hr. to 300 kw. hr. of energy. The higher consumption is for mixtures high in copper, which require a greater temperature.

It was stated in an informal discussion after the close of the meeting that whereas oil-fired furnaces are limited to a capacity of about 1,000 lb. (450 kg.) of brass each, there are now in operation "Bennett" three-phase brass furnaces with capacities up to 5 tons (4,500 kg.) of brass each. These furnaces have not yet been placed on the market, but there was said to be an installation in actual operation aggregating some 2,500 kw.

The time of flight for the shell of the long range gun which bombarded Paris was three minutes, and during the 76-miles flight the rotation of the earth added nearly half a mile to the distance. A very interesting point is that the average flight of the projectile is in a 28½-in. vacuum.

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DRAFTSMAN A FIRST-CLASS MECHANICAL Draftsman experienced on Automatic Machines, Jigs and fixtures for small interchangeable work; also a Junior Draftsman, must be a good penman. Permanent positions with good opportunity for advancement. Apply by letter or in person to The Singer Manufacturing Co., St. Johns, P.Q. State age, experience and salary expected. (c4m)

WANTED MAN AS SHOP ASSISTANT TO Master Mechanic in a large manufacturing plant. Must be familiar with modern shop practice, capable of installing machinery to the best advantage, and completing the work speedily. Good opportunity for an energetic man. State experience, age, salary, etc., in first letter. Box 616, Canadian Machinery. (c4m)

AGENCIES WANTED

WANTED AGENCY OF SPECIALTIES FOR hardware factories and mills for Quebec city and district. Best connections and references. Reply to G. A. Vandry, 28 St. Joseph St., Quebec. (c8m)

MACHINE WORK WANTED

MACHINE WORK WANTED FOR LATHES, shapers, milling machine and planer, etc. Hourly or contract basis. Prompt delivery. W. H. Sumbling Machinery Co., Toronto. (ctfm)

PATTERNS

TORONTO PATTERN WORKS, 65 JARVIS Street, Toronto. Patterns in wood and metal for all kinds of machinery. (cfm)

BRANTFORD PATTERN WORKS ARE PREpared to make up patterns of any kind—including marine works—to sketches, blue prints or sample castings. Prompt, efficient service. Bell 'Phone 631; Machine 'Phone 733. Brantford Pattern Works, 49 George St., Brantford, Ont. (ctfm)

DRAIN TENDERS WANTED

Tenders will be received by the undersigned Commissioners up till 2 o'clock p.m. Saturday, the 26th day of July, 1919, for the repair to the 3-4 Sideroad and 8-9 Concession drain, in the Township of Brooke, County of Lambton. Estimate cost of excavation, $9,600. Contractors must furnish security for the completion of the work. Plans and specifications may be seen at the office of the Clerk, Lot 16, Con. 9, Brooke Township. Lowest or any tender not necessarily accepted.

L. LINDSAY, R.R. No. 2, Alvinston.
C. ATKIN, R.R. No. 1, Inwood.
Commissioners. (c4m)

FOR SALE

17 ATLAS HORIZONTAL TUBULAR BOILERS (Babcock & Wilcox), 60 inch by 16 feet with Jones Underfeed Stokers. Dominion Sugar Co., Limited, Chatham, Ont. (c8m)

FOR SALE — FINE BIG ENGINE LATHE about 9" x 30 ft. Box 610, Canadian Machinery.

BOILERS FOR SALE

ALL IN EXCEPTIONALLY GOOD CONDITION. 17 Atlas Horizontal Tubular Boilers (Babcock & Wilcox), 60 inch by 16 feet, with Jones Underfeed Stokers; boilers lying at Kitchener. One 350 H.P. Erie City Boiler. Four 250 H.P. Scotch Marine Boilers with wet heads, now lying at Wallaceburg plant. Dominion Sugar Co., Limited, Chatham, Ontario. (c8m)

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MECHANICAL ENGINEER AND DRAUGHTSman, with experience in dredging, hoisting and general engineering open for position. Box 617, Canadian Machinery. (c9m)

WANTED—POSITION AS TOOL ROOM OR machine shop foreman by man of ability; good references. Apply Box 618 Canadian Machinery. (c9m)

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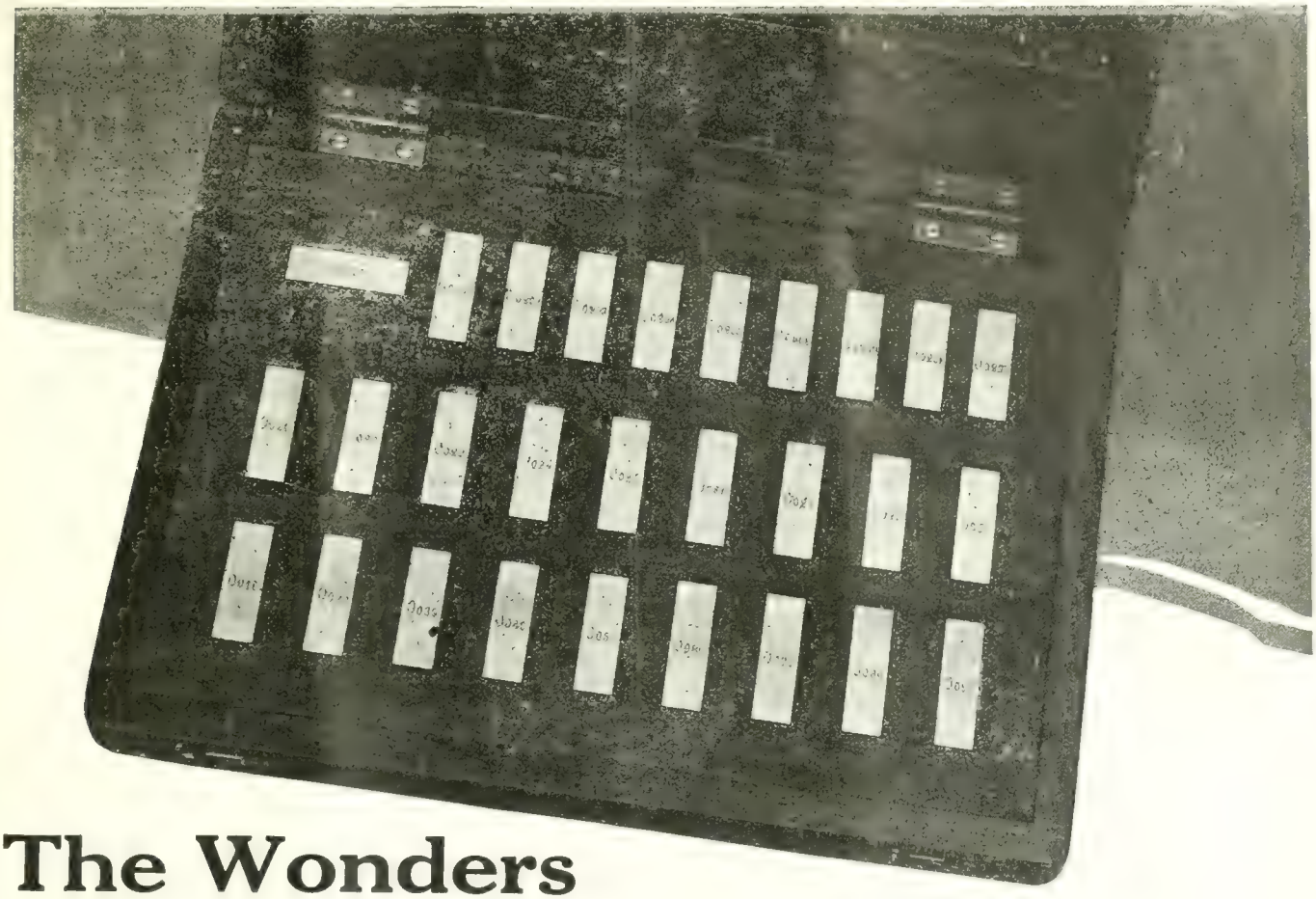


The Wonders of Set Number FOUR

There seems to be renewed interest in Set Number Four Johansson Gage Blocks—doubtless due to the increased interest being shown in gages generally. Johansson Set Number Four has never stopped being the wonder of mechanics wherever shown.

A number of the best toolshops now have these twenty-eight thin gages, and the opinion is that they would scarcely know how to get on without them.

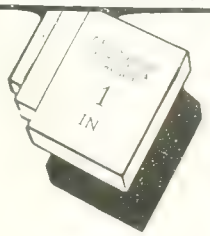
Set Number Four does permit a shop to enjoy the full advantage of the Johansson System. To a user of our Set Number One, these "feeler" gages practically double the number of combinations possible. And not only this, but they permit a range of small sizes that no other set of gages in existence can give. The mechanic's particular attention is called to the gage in this set marked .010" (one hundredth of an inch) in thickness, with two parallel surfaces and of a quality steel that will hold its size and shape.

When a mechanic gets a Set Number Four in his hands for examination, his thought is "How does Johansson produce such gages commercially?"

The sale of Set Number Four is confined to users of Johansson Set Number One as these thin gages are intended only as an addition to the big set.

Let one of our men call and show you where you can use a set of these gages. We can make immediate delivery.

Johansson
ACCURACY



C. E. JOHANSSON, Inc., 72 Queen St. West, TORONTO

Successors to SWEDISH GAGE CO.
245 West 55th St., NEW YORK CITY

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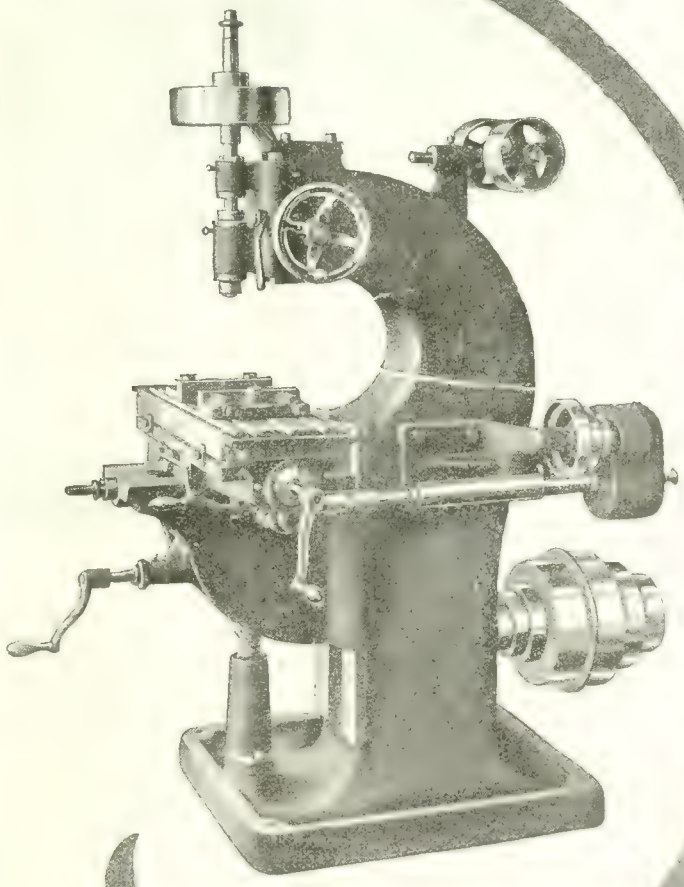
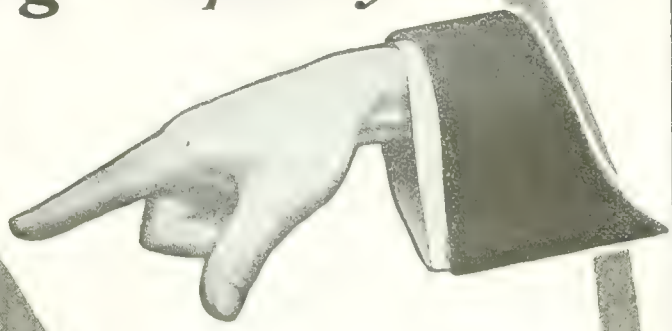
Bristol Vertical Milling Machine

A Tool of Large Capacity





Ball Bearings are used at the most important points making it a free running tool, which, combined with its being a belt-driven machine, makes it capable of turning out work on which an extra smooth finish is desired.

The longitudinal table feed is controlled by the gear change box which gives six different feeds for each change of spindle speed. A stop to gauge with micrometer adjustment is used on the head to regulate the depth of cuts.

Learn all about its production capacity.

Write for bulletin giving fullest particulars.

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SUCCESSORS TO C. G. GARRIGUS MACH. CO.
BRISTOL, CONN.

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Marshall, Son & Bunney, Toronto
Norton, Ralph B. Agent Montreal

BILLETS, FORGING
General Steel Co. Milwaukee Wis
Kayser Ellison & Co. Ltd Montreal
Norton, Ralph B. Agent Montreal

BINS, STEEL
Dennis Wire & Iron Works, London, Ont
Dominion Bridge Co. Montreal Que.
McKinnon Steel Co. Sherbrooke, Que
Toronto Iron Works Ltd. Toronto, Ont.

BLACKSMITH WORK
The Thos. Pink Co., Ltd., Pembroke.

BLANKING
H. Hope & Sons Co. Ltd. Peterboro

BLASTING MACHINES, SHOT AND STEEL GRIT
Pittsburgh Crushed Steel Co. Pittsburgh

BLOOMS AND SLABS
Algoma Steel Corp., Sault Ste. Marie

BLOWERS
Can. Blower & Forge Co., Kitchener, Ont.
Garlock-Walker Machinery Co. Toronto
McGowan & Co. Montreal Que
Williams & Wilson Limited Montreal.

BLOCK, CHAIN AND ROPE
Fellows Bros., Ltd. Chadley Heath, Eng.

BLOCKS, CARGO
Fellows Bros., Ltd., Chadley Heath, Eng.

BLOW PIPES AND REGULATORS
Carter Welding Co., Toronto, Ont.
Prest-O-Lite Co., Inc., Toronto, Ont
Welding & Supplies Co., Montreal, Que.

BLUE PRINTING MACHINERY
Commercial Camera Co., Providence, R.I.
Wickes Bros. Saginaw, Mich

BOARDS, GLASS CUTTING
Larkin Rule Co., of Can., Windsor, Ont.

BOARTZ
Jones, Koebel & Co., Inc., New York

BOLT CUTTERS
Greenfield Tap & Die Corp., Greenfield, Mass

BOLT CUTTERS
Fellows Gear Shaper Co., Springfield, Vt.
Greenfield Tap & Die Corp., Greenfield, Mass
Wells Bros., of Can., Galt, Ont.
Williams & Wilson, Ltd., Montreal, Que

BOOKS, TECHNICAL
MacLean Publishing Co., Toronto.

BOILERS
Dominion Bridge Co. Montreal Que
MacGovern & Co., Montreal, Que
MacKinnon Steel Co., Sherbrooke, Que.

BOLT CUTTERS AND NUT TAPERS
Aikenhead Hardware Co., Toronto, Ont.
Canadian Machinery Corp., Galt, Ont.
Garlock-Walker Machinery Co., Toronto.
Landis Machine Co., Waynesboro, Pa.
A.B. Jardine & Co., Ltd., Hespeler, Ont.
Rice Lewis & Son, Toronto, Ont.
Wells Bros. Co. of Canada, Galt, Ont
Williams & Wilson, Limited, Montreal.

BOLTS
Aikenhead Hardware Co. Toronto, Ont.
Lamson Bolt & Hinge Works, London, Ont
Morrow Screw & Nut Co., John, Ingersoll.
Rice Lewis & Son, Toronto, Ont.
Steel Co. of Canada, Ltd. Hamilton.
Wilkinson & Kompass, Hamilton, Ont.
Williams & Co. J. H. Brooklyn, N.Y.

BOLTS, STAY
Morrow Screw & Nut Co., John Ingersoll.

BOLTS, SPRING SHAKLE
Can. Winkley Co., Ltd., Windsor, Ont.
Morrow Screw & Nut Co. John, Ingersoll.

BOLTS, PATCH
Morrow Screw & Nut Co. John Ingersoll.

BOLT AND NUT MACHINERY
Bertram & Sons Co. John Dundas, Ont
Canada Machinery Corp. Galt, Ont
Garlock-Walker Machinery Co., Toronto.
Gardner & Son, Robert, Montreal
Landis Machine Co., Waynesboro, Pa.
National Acme Co., Cleveland, Ohio.
National Machinery Co. Tiffin, Ohio
Williams & Wilson Ltd Montreal, Que.
Williams Machinery Co., A. R., Toronto

BOLT THREADING MACHINERY
Jardine & Co. Ltd., B. Hespeler
Landis Machine Co. Waynesboro Pa.
National Acme Co., Cleveland, Ohio
Victor Tool Co., Waynesboro, Pa.
Williams & Wilson Limited Montreal

BORING MACHINES, PNEUMATIC CYLINDER
Cleveland Pneumatic Tool Co., Toronto.
Canadian Ingersoll-Rand Co. Sherbrooke Que
Garlock Walker Machinery Co. Toronto

BORING MACHINES, UPRIGHT AND HORIZONTAL
Bertram & Sons Co. John Dundas
Betts Machine Co., Rochester, N.Y.
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Machinery Co. Toronto
Gisholt Machine Co. Madison, Wis
Gardner Machine Co. Beloit, Wis
Hoefer Mfg. Co., Freeport, Ill.
Landis Tool Co., Waynesboro, Pa.
Niles-Bement-Pond Co. New York
Rochester Machine & Tool Co. Rochester
Williams & Wilson Ltd Montreal Que

BORING AND TURNING MILLS
Bertram & Sons Co. John Dundas
Betts Machine Co. Rochester, N.Y.
Canada Machinery Corp. Galt, Ont
Gisholt Machine Co. Madison, Wis
Geo. F. Foss Mchy. & Sply. Co. Montreal
Oliver Mfg. Co., Grand Rapids, Mich

Niles-Bement-Pond Co., New York.
Williams & Wilson, Ltd., Montreal, Que.

BOXES, STEEL SHOP AND TOTE
Cleveland Wire Spring Co., Cleveland.

BRAKEBAND LINING CUTTERS
Peck Stow & Wilcox Co., Southington, Conn.

BRAKES
Brown, Boggs & Co., Hamilton, Can.
Electric Steel & Metals Ltd., Welland.

BRASS AND COPPER BARS, RODS BRAKES, CORNICES
Peck Stow & Wilcox Co., Southington, Conn.

BRASS FOUNDERS
Canada Metal Co., Toronto.
[illegible], Peterboro, Ont.
St. Lawrence Welding Co., Montreal.
Tallman Brass & Metal Co., Hamilton.
Wilson & Co., J. C., Belleville, Ont.

BRASS WORKING MACHINERY
[illegible] Machine Co., [illegible], Ltd.
Garlock-Walker Machinery Co., Toronto.
Warner & Swasey Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Roelofson Machine & Tool Co., Toronto, Ont.
Wood Turret Machine Co., Brazil, Ind.
Williams Machinery Co., A. R., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

BRICKS, FIRE
Harbison Walker Refractories, Montreal.

BRIDGES, RLY. AND HIGHWAY
Dominion Bridge Co., Montreal, Que.
MacKinnon Steel Co., Sherbrooke, Que.

BRONZE RODS AND SHEETS, PLATES
Brown's Copper & Brass Rolling Mills, New Toronto.

BRONZE, NAVAL
Brown's Copper & Brass Rolling Mills, New Toronto.
Canada Metal Co., Toronto.
Tallman Brass and Metal Co., Hamilton.

BRONZE COPPER
Canada Metal Co., Toronto.

BUFFING AND POLISHING MACHINERY
Ford-Smith Mach. Co., Hamilton.
Foss Mchy. & S'ply Co., Geo. F., Montreal.
Garlock-Walker Machinery Co., Toronto.
Williams & Wilson, Limited, Montreal.

BUCKETS, DUMP
MacKinnon Steel Co., Sherbrooke, Que.
Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.

BUCKETS, ELEVATOR
Can. Link-Belt Co., Toronto, Ont.
MacKinnon Steel Co., Sherbrooke, Que.

BUCKETS, CLAM SHELL, CRAB, DUMP
Can. Link-Belt Co., Toronto, Ont.
Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.
Northern Crane Works, Ltd, Walkerville.

BULLDOZERS
Bertram & Sons Co., John, Dundas.
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Machinery Co., Toronto.
Williams & Wilson, Limited, Montreal.

BURNERS, OIL AND NATURAL GAS
Northern Crane Works, Ltd., Walkerville.

BURRS, IRON AND COPPER
Parmenter & Bulloch Co., Gananoque.

BUSHINGS, BRONZE
Morrow Screw & Nut Co., John, Ingersoll.

CALIPERS
Pangborn Corporation, Hagerstown, Md.
Peck Stow & Wilcox Co., Southington, Conn.

CABINETS, SAND BLAST
Pangborn Corporation, Hagerstown, Md.

CABLE, ELECTRIC
International Machinery & Supply Co., Ltd., Montreal, Que.

CALKS, BOOT
Lufkin Rule Co., of Can., Windsor, Ont.

CANADA SILVER SHEETS, ROLLS
Brown's Copper & Brass Rolling Mills, New Toronto.

CANNERS' MACHINERY
Bliss, E. W. Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Can.

CANNERS' CONVEYORS
Can. Link-Belt Co., Toronto, Ont.
Wilson & Co., J. C., Belleville, Ont.

CARBONIZING BOXES
Can. Driver-Harris Co., Ltd., Walkerville
Katie Foundry, Galt, Ont.
Morris Crane & Hoist Co., Ltd., Herbert, Niagara Falls, Ont.
Swedish Crucible Steel Co., Windsor.

CARRIERS, PNEUMATIC TUBE
Jones & Glassco, Montreal.

CARS, INDUSTRIAL
Can. Blower & Forge Co., Kitchener, Ont.
Can. Fairbanks-Morse Co., Ltd., Montreal.
Morris Crane & Hoist Co., Ltd., Herbert, Niagara Falls, Ont.

CASTINGS, MACHINERY
Wilson & Co., J. C., Belleville, Ont.

CASTINGS, ALUMINUM, BRASS BRONZE, COPPER, AND GUN METAL
Algoma Steel Corp., Sault Ste. Marie.
Brockville Foundry Co., Brockville, Ont.
Franklin Mfg. Co., Syracuse, N.Y.
Canada Metal Co., Ltd., Toronto, Ont.

CASTINGS, DIE CAST
Canada Metal Co., Ltd., Toronto, Ont.
Franklin Mfg. Co., Syracuse, N.Y.

CASTINGS, STEEL—ALL KINDS
Electric Steel & Metals Co., Welland.
Fellows Bros., Ltd., Chadley Heath, Eng.

CARRIERS COUPLING BOLTS
John Morrow Screw & Nut Co., Ingersoll.
Alexander Fleck, Ltd., Ottawa.
Greenleafs Ltd., Belleville, Ont.
St. Lawrence Welding Co., Montreal.
Tallman Brass & Metal Co., Hamilton.

CASTINGS, BRASS AND IRON
Algoma Steel Corp., Sault Ste. Marie.
International Machinery and Supply Co., Ltd., Montreal, Que.

CASTINGS, BUILDING
Katie Foundry, Galt, Ont.

CASTINGS, GRAY IRON
Bernard Industrial Co., A., Fortierville, Q.
Brown, Boggs Co., Ltd., Hamilton.
Alexander Fleck, Ltd., Ottawa.
Gardner & Son, Robt., Montreal.
Greenleafs, Ltd., Belleville, Ont.
Hull Iron & Steel Foundries, Ltd., Hull.
International Malleable Iron Co., Guelph.
Kennedy & Sons, Ltd., Wm., Owen Sound.
Katie Foundry, Ltd., Galt, Ont.
Hamilton Co., Wm., Peterboro.
Wilson & Co., J. C., Belleville, Ont.

CASTINGS, PLUMBERS'
Katie Foundry, Galt, Ont.

CASTINGS, NICHROME
Can. Driver-Harris Co., Ltd., Walkerville

CASTINGS, HARDWARE
Katie Foundry, Galt, Ont.

CASTINGS, STEEL CHROME AND MANGANESE STEEL
Thos. Davidson Mfg. Co., Montreal, Que.
Dom. Foundries & Steel, Hamilton, Ont.
Hull Iron & Steel Foundries, Ltd., Hull.
Kennedy & Sons, Ltd, Owen Sound.

CASTINGS, MALLEABLE
International Malleable Iron Co., Guelph

CASTINGS, NICKEL STEEL
Hull Iron & Steel Foundries, Ltd., Hull.

CEMENT MACHINERY
Can. Fairbanks-Morse Co., Ltd., Montreal.
Gardner, Robt., & Son, Montreal.

CEMENT HANDLING MACHINERY
Can. Link-Belt Co., Toronto, Ont.

CENTERING MACHINES
Victoria Foundry Co., Ottawa, Ont.

CENTRE REAMERS
Bertram & Sons Co., John, Dundas.
Gardner, Robt. & Son, Montreal.
Hurlburt, Rogers Mch. Co., South Sudbury, Mass.
Morrow Screw & Nut Co., J., Ingersoll, Ont
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Wells Bros. Co., of Canada, Galt, Ont.

CHAIN, WELDED COIL
Fellows Bros., Ltd., Chadley Heath, Eng.
Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.

CHAIN BLOCKS
Aikenhead Hardware Co., Toronto, Ont.
Can. Fairbanks-Morse Co., Ltd., Montreal
Ford Chain Block & Mfg. Co., Phila., Pa.
Garlock-Walker Machy. Co., Toronto.
Morris Crane & HoistCo., Herbert, Niagara Falls, Ont.
Rice Lewis & Son, Toronto, Ont.
Williams & Wilson, Ltd., Montreal, Que.
Jones & Glassco, Montreal, Que

CHAINS, AGRICULTURAL
Morse Chain Co., Ithaca, New York.

CHAINS, AUTOMOBILE ENGINE
Morse Chain Co., Ithaca, New York.

CHAINS, BOOM, TIMBER
Fellows Bros., Ltd., Chadley Heath, Eng.

CHAINS, BICYCLE, DRIVE AND BLOCK
Morse Chain Co., Ithaca, New York.

CHAINS, FORGED
Fellows Bros., Ltd., Chadley Heath, Eng.

CHAINS, FOR ELEVATORS AND CONVEYORS
Can. Link-Belt Co., Toronto, Ont.
Morse Chain Co., Ithaca, N.Y.
Williams & Wilson, Ltd., Montreal, Que.

CHAIN, MALLEABLE, DETACHABLE AND RIVETED
Can. Link-Belt Co., Toronto, Ont.
Morse Chain Co., Ithaca, N.Y.
Williams & Wilson Ltd., Montreal, Que.

CHAINS, POWER TRANSMISSION
Morse Chain Co., Ithaca, N.Y.

CHAINS, SPROCKET WHEEL
Morse Chain Co., Ithaca, N.Y.

CHAIN DRIVES
Can. Link-Belt Co., Toronto, Ont.
Coventry Chain Co., Coventry, England.
Jones & Glassco, Montreal, Que.
Morse Chain Co., Ithaca, N.Y.

CHASERS
National Acme Co., Cleveland, Ohio.
Taylor, J. A. M., 318 Stair Bldg., Toronto, Ont.

CHEMISTS
Toronto Testing Lab'tory, Ltd., Toronto

CHUCKS, AERO, AUTOMATIC
Garvin Machine Co., New York.

CHUCKS, COLLET, AIR
Elliott & Whitehall Mach. & Tool Co. Galt, Ont.
Smalley-General Co., Inc., Bay City, Mich.
Williams & Wilson, Ltd., Montreal, Que.

CHUCKS, DRILL, LATHE AND UNIVERSAL
Aikenhead Hardware Co., Toronto, Ont.
Almond Mfg. Co., Ashburnham, Mass.
Bicknell-Thomas Co., Greenfield, Mass.
Bertram & Sons Co., John, Dundas.
Can. Blower & Forge Co., Kitchener, Ont.
Can. Fairbanks-Morse Co., Ltd., Montreal
Cushman Chuck Co., Hartford, Conn.
Foss Mchy. & S'ply Co., G. F., Montreal.
Gardner, Robt., & Son, Montreal.
Garlock-Walker Mach'y Co., Toronto.
Gisholt Machine Co., Madison, Wis.
Hardinge Bros., Chicago, Ill.
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Rice Lewis & Son, Toronto, Ont.
Skinner Chuck Co., New Britain, Conn.
Whiton Machine Co., D. E., New London, Conn.
Williams & Wilson, Ltd., Montreal, Que

CHUCKS, DRILL, AUTOMATIC AND KEYLESS
Aikenhead Hardware Co., Toronto, Ont
Bicknell-Thomas Co., Greenfield, Mass.
Can. Blower & Forge Co., Kitchener.
Whitney Mfg. Co., Hartford, Conn.

CHUCKS, FRICTION AND TAP
Bicknell-Thomas Co., Greenfield, Mass.
Victor Tool Co., Waynesboro, Pa.

CHUCKS, MAGNETIC
Heald Machine Co., Worcester, Mass.
Williams & Wilson, Ltd., Montreal, Que.

CHUCKS, RING WHEEL
Ford-Smith Mach. Co., Hamilton, Ont.
Gardner Machine Co., Beloit, Wis.

CHUCKING MACHINES
Garvin Machine Co., New York.
Gisholt Machine Co., Madison, Wis.
National Acme Co., Windsor, Vt.
Niles-Bement-Pond Co., New York.
Roelofson Machine & Tool Co., Toronto.
Warner & Swasey Co., Cleveland, O.
Wood Turret Mach. Co., Brazil, Ind.
Williams & Wilson, Ltd., Montreal, Que.

CIRCULATING SYSTEMS FOR LUBRICATING OIL
Bowser & Co., Inc., Fort Wayne, Ind.
Williams & Co., J. H., Brooklyn, N.Y.

CLEANING COMPOUND
Oakley Chemical Co., New York.

CLOCK SPRINGS
The Dunbar Brothers Co., Bristol, Conn.

CLOCKS, WATCHMAN, PORTABLE
Gisholt Machine Co., Madison, Wis.
Hardinge Bros., Inc., Chicago, Ill.

CLUTCHES, CHAIN
Wright Mfg. Co., Lisbon, Ohio.

CLUTCHES, FRICTION AND PULLEY
Bernard Industrial Co., A., Fortierville, Q.
Can. Link-Belt Co., Toronto, Ont.
Carlyle Johnson Mach. Co., Manchester, Conn.
Jones & Glassco, Montreal, Que.
Positivte Clutch & Pulley Wks., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

COAL HANDLING MACHINERY
Bond Engineering Works, Toronto, Ont.
Can. Link-Belt Co., Toronto, Ont.
Dominion Bridge Co., Montreal, Que.
MacGovern & Co., Montreal, Que.
MacKinnon Steel Co., Sherbrooke, Que.
Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.
Northern Crane Works, Walkerville, Ont.
Williams & Wilson, Limited, Montreal.

COILING MACHINERY, WIRE AND SPRING
Garlock Walker Machinery Co., Toronto.
Sleeper & Hartley, Inc., Worcester, Mass.

COKE AND COAL
Hanna & Co., M. A., Cleveland, O.

Nova Scotia Steel & Coal Co., New Glasgow, N.S.

COLD ROLLED STRIP, ALL METAL COLLARS, SHAFTING
Can. Driver-Harris Co., Ltd., Walkerville.
Wilson & Co., J. C., Belleville, Ont.
Williams & Co., J. H., Brooklyn, N.Y.
Williams & Wilson, Ltd., Montreal, Que.

COLLECTORS, PNEUMATIC
Can. Blower & Forge Co., Kitchener.
J. C. Wilson & Co., Belleville, Ont.

COLLETS
Becker Milling Machine Co., Boston.
Hardinge Bros., Inc., Chicago, Ill.
Wilson & Co., J. C. Belleville, Ont.

COMPOSITION INGOT
Brown's Copper & Brass Rolling Millls, New Toronto.
Canada Metal Co., Toronto, Ont.

COMBINED OPEN SIDE PLANER-SHAPER
Lynd-Farquhar Co., Boston, Mass.

COMPRESSORS, AIR
Can. Ingersoll-Rand Co., Sherbrooke.
Cleveland Pneumatic Tool Co., Toronto.
Curtis Pneumatic Machy. Co., St. Louis
Garlock-Walker Machy. Co., Toronto.
Hinckley Machine Co., Hinckley, Ill.
MacGovern & Co., Montreal, Que.
Williams & Wilson, Ltd., Montreal, Que

CONDENSERS
MacGovern & Co., Montreal, Que.
Smalley-General Co., Inc., Bay City, Mich.

CONNECTING RODS
Canada Found's & Forgings, Ltd., Welland, Ont.

CONTRACT WORK
Banfield, W. H., & Sons, Toronto.
Brown Engineering Corp., Toronto.
Ford-Smith Machine Co., Hamilton, Ont.
Homer & Wilson, Hamilton, Ont.
Katie Foundry, Ltd., Galt, Ont.
Marten Machine Co., Hamilton, Ont.
St. Lawrence Welding Co., Montreal.
Victoria Foundry Co., Ottawa.
Wilson & Co., J. C., Belleville, Ont.
Windsor Mach. Tool Co., Windsor, Ont.

CONTROLLERS, MAGNETIC BRAKES, ELEC. WINCHES, MONO RAIL HOISTS
Volta Mfg. Co., Welland, Ont.

CONTROLLERS AND STARTERS
Williams Mach'y Co., A. R., Toronto.

CONTROLLING INSTRUMENTS
Taylor Instrument Co., Rochester, N.Y.

CONVERTERS, ROTARY
MacGovern & Co., Montreal, Que.

CONVEYORS, BELT AND CHAIN
Can. Link-Belt Co., Toronto, Ont.
Jones & Glassco, Montreal.

COOLERS, WITH DRINKING FOUNTAINS
Puro Sanitary Drinking Fountain Co., Haydenville, Mass.

COPING MACHINES
Bertram & Sons Co., John, Dundas, Ont.
Garlock-Walker Machinery Co., Toronto.
Niles-Bement-Pond Co., New York.
Can. Blower & Forge Co., Kitchener.

COPPER, BUS BAR, SHEET, PATES, RODS
Brown's Copper & Brass Rolling Mills, New Toronto, Ont.

COUNTERBORES AND COUNTERSINKS
Aikenhead Hardware Co., Toronto, Ont.
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Dundas, Ont.
Rice Lewis & Son, Toronto, Ont.

COUNTERSHAFTS
Almond Mfg. Co., Ashburnham, Mass.
Gray Ball Bearing Co., Ltd., Toronto.
Baird Machine Co., Bridgeport, Conn.
Ford-Smith Machine Co., Hamilton, Ont.
Foster Machine Co., Elkhart, Ind.
Williams & Wilson, Ltd., Montreal, Que.

COUPLINGS, FRICTION
Bernard Industrial Co., The A., Fortierville, Que.
Can. Link-Belt Co., Toronto, Ont.
Williams & Wilson, Ltd., Montreal, Que

COUPLINGS, RAPID HOSE
Int. Machinery & Supply Co., Ltd., Montreal, Que.

COUPLINGS, PLAIN, FLEXIBLE AND CUT OFF
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Gardner, Robt. & Son, Montreal.
Independent Pneumatic Tool Co., Chicago
Wilson & Co., J. C., Belleville, Ont.

CRANES, LOCOMOTIVE
Can. Link-Belt Co., Toronto, Ont.
Northern Crane Works, Walkerville.

CUPS, OIL
[illegible]

COVERS, OIL HOLE
[illegible]

CRANES, GANTRY
[illegible]
Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.
Northern Crane Works, Walkerville.

CRANE RUNWAYS
[illegible]

CRANES, GOLIATH, PNEUMATIC AND PORTABLE
Morris Crane and Hoist Co., Herbert, Niagara Falls, Ont.
Northern Crane Works, Walkerville.
[illegible] Belleville.
Williams & Wilson, Ltd., Montreal, Que.

CRANES, TRAVELLING, ELECTRIC AND HAND POWER
[illegible] Toronto, Ont.
[illegible] Machy. Co., St. Louis
[illegible] Bridge Co., Montreal
[illegible] Ltd., Toronto
[illegible] Steel Co., Sherbrooke, Que.
Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.
Niles-Bement-Pond Co., New York
Northern Crane Works, Walkerville

CRANES, TRAVELLING AND JIB
Fellows Bros. Ltd., Chadley Heath, Eng.

CRANK SHAFTS
Canada Forgings & Forgings Ltd., Welland
Williams & Co., J. H., Brooklyn, N.Y.

CRANES, PORTABLE
Aikenhead Hardware Co., Toronto, Ont.
[illegible] Toronto
Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.
Northern Crane Works, Walkerville.
Rice Lewis & Son, Toronto, Ont.
J. C. Wilson & Co., Belleville, Ont.
Williams & Wilson, Ltd., Montreal, Que.

CRIMPS, LEATHER
Graton & Knight Mfg. Co., Worcester, Mass.

CRUSHED STEEL
Pittsburgh Crushed Steel Co., Pittsburgh

CUPOLAS
Can. Blower & Forge Co., Kitchener.
Northern Crane Works, Walkerville.

CURB PUMPS FOR OIL, GASOLINE
Bowser & Co., S. F., Inc., Fort Wayne, Ind.

CURRENT TRANSFORMERS
Electric Steel & Metals, Ltd., Welland.

CUT-OFF COUPLINGS, FRICTION
J. C. Wilson & Co., Belleville, Ont.
Williams & Wilson, Ltd., Montreal, Que.

CUTTERS, BOLT
See Bolt Cutters.

GEAR CUTTERS
Fellows Gear Shaper Co., Sprinfigeld, Vt.

CUTTERS, FLUE
Cleveland Pneumatic Tool Co., Toronto.

CUTTER HEADS
Oliver Machinery Co., Grand Rapids, Mich

CUTTERS, PIPE (See Pipe Cutters)

CUTTERS, MILLING
Becker Milling Mach. Co., Boston, Mass
Boker & Co., Inc., H., Montreal, Que.
Butterfield & Co., Rock Island, Que
Can. Fairbanks-Morse Co., Ltd., Montreal
Cleveland Twist Drill Co., Cleveland.
Davis Tool Mfg. Co., New York, N.Y.
Elliott & Whitehall Mach. & Tool Co., Galt, Ont.
Foss Mchy. & S'ply Co., G. F., Montreal.
Garvin Machine Co., New York.
Illinois Tool Works, Chicago, Ill.
Morse Twist Drill & Machine Co., New Bedford.
Pratt & Whitney Co., Dundas, Ont.
Pilot Steel & Tool Co., Montreal, Que.
Rice Lewis & Son, Toronto, Ont.
Tabor Mfg. Co., Philadelphia, Pa
[illegible] Mfg. Co., Hartford, Conn

CUTTING-OFF MACHINES
Armstrong Bros., Tool Co., Chicago.
Bertram & Sons Co., John, Dundas.
Can. Fairbanks-Morse Co., Ltd., Montreal
Curtis & Curtis Co., Bridgeport, Conn.
Foss Mchy & S'ply Co., Geo. F., Montreal
Garlock-Walker Machinery Co., Toronto
Garvin Machine Co., New York.
Greenfield Tap & Die Corp., Greenfield, Mass.
[illegible] Mach. Co., South [illegible], Mass.
Hall & Sons, John H., Brantford, Ont
Kennedy & Sons, Wm., Owen Sound.
Niles-Bement-Pond Co., New York, N.Y.
[illegible] Machine Co., Racine, Wis
Prest-O-Lite Co., Inc., Toronto, Ont.
Racine Tool & Machine Co., Racine, Wis
Standard Machy. & Supplies, Montreal
Tabor Mfg. Co., Philadelphia, Pa.
Wells Bros. of Can., Galt, Ont
Williams & Wilson, Ltd., Montreal, Que.

CUTTING COMPOUND AND CUTTING OIL
Cataract Refining Co., Ltd., Toronto.

CUTTING OIL, RECLAIMING SYSTEM
Bowser & Co., Inc., Fort Wayne, Ind

CUTTING AND WELDING PLANTS
[illegible] Ont.
[illegible] Que.

CYANIDE AND LEAD BATH POTS
Swedish Crucible Steel Co., Windsor

CYLINDERS, AIR
Ford-Smith Machine Co., Hamilton, Ont.
Stirling General Co., Inc., Bay City, Mich

CYLINDERS, AUTOMATIC REBORING JIGS AND REAMERS
[illegible] Machine Co., [illegible], Ill.
[illegible] Reamer Co., Cleveland, O.

DERRICKS
Aikenhead Hardware Co., Toronto, Ont.
Dominion Bridge Co., Montreal
Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.

DIAMOND TOOLS
Anderson & Co., of Can., Geo., Montreal
Ford-Smith Machine Co., Hamilton, Ont.
Joys Koebel Co., Inc., New York City.
Wheel Trueing Tool Co., Detroit
Williams & Wilson, Limited, Montreal.

DIAMONDS, CARBON AND BORTZ
Wheel Trueing Tool Co., Detroit

DIAMONDS, BLACK AND ROUGH
Joys Koebel & Co., Inc., New York.
Wheel Trueing Tool Co., Windsor, Ont.

DIE BLOCKS
General Steel Co., Milwaukee, Wis.

DIE HEADS, AUTOMATIC
Greenfield Tap & Die Corp., Greenfield Mass.
Wells Bros. of Can., Galt, Ont.
Williams & Wilson, Ltd., Montreal, Que.

DIES, BRASS PRINTING, EMBOSSING AND LETTERING
Matthews, Jas. H., & Co., Pittsburgh, Pa
Pittsburgh Steel Stamp Co., Pittsburgh.

DIES FOR BIT BRACE USE
Butterfield & Co., Rock Island, Que.
A. B. Jardine & Co., Ltd., Hespeler, Ont.
Wells Brothers Co., of Canada, Galt.

DIES AND DIE STOCKS
Aikenhead Hardware Co., Toronto, Ont.
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Banfield, W. H., & Son, Toronto.
Boker & Co., Inc., H., Montreal, Que.
Butterfield & Co., Rock Island, Que.
Brown, Boggs Co., Hamilton, Ont.
Can. Fairbanks-Morse Co., Montreal.
Foss Mchy. & S'ply Co., G. F., Montreal.
Gardner, Robt. & Son, Montreal.
A. B. Jardine & Co., Hespeler, Ont.
Landis Machine Co., Waynesboro, Pa.
Marshall, Son & Bunney, Toronto.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Acme Co., Cleveland, Ohio.
Pilot Steel & Tool Co., Montreal, Que.
Pratt & Whitney Co., Dundas, Ont.
Rice Lewis & Son, Toronto, Ont.
Rickert-Shafer Co., Erie, Pa.
Standard Machy. & Supplies, Montreal.
Stoll Co., Inc., D. H., Buffalo, N.Y.
Wells Brothers of Canada, Galt, Ont.
Williams & Wilson, Ltd., Montreal, Que

DIES, PIPE THREADING
A. B. Jardine & Co., Ltd., Hespeler, Ont.
Butterfield & Co., Rock Island, Que.
Landis Machine Co., Waynesboro, Pa.
Williams & Wilson, Ltd., Montreal, Que.

DIES, THREADING
Greenfield Tap & Die Corp., Greenfield, Mass.
Wells Bros. of Can., Galt, Ont.

DIE SINKERS
Becker Milling Machine Co., Boston
Garvin Machine Co., New York.
Pratt & Whitney Co., Dundas, Ont.

DIES FOR MACHINES
Aikenhead Hardware Co., Toronto, Ont.
Butterfield & Co., Rock Island, Que.
Firth & Sons, Thos., Montreal, Que.
Landis Machine Co., Waynesboro, Pa.
Wells Brothers Co. of Canada, Galt.

DIE HEADS
Greenfield Tap & Die Corp., Greenfield, Mass.
Wells Bros. of Canada, Galt, Ont.

DIES, SELF-OPENING
Geometric Tool Co., New Haven.
Landis Machine Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Murchey Machine & Tool Co., Detroit.
Wells Brothers Co. of Can., Galt, Ont.
Williams & Wilson, Ltd., Montreal, Que.

DIE FILING MACHINES
Oliver Mach. Co., Grand Rapids, Mich.

DIE STEEL, HOT AND COLD WORK
Armstrong-Whitworth of Can., Montreal.
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Marshall, Son & Bunney, Toronto.
Firth & Sons, Thos., Montreal, Que.
Kayser-Ellison & Co., Ltd., Montreal.
Norton, Ralph B., Agent, Montreal.

DIES FOR SCREW PLATES
Wells Bros. Co. of Can., Galt, Ont.

DIES, SHEET METAL WORKING
E. W. Bliss Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Canada
Illinois Tool Works, Chicago, Ill.
Mason Machine Co., Hamilton, Ont.
Stoll Co., D. H., Buffalo, N.Y.
Windsor Mach. & Tool Co., Windsor.

DIES, SCREW AND THREAD
Butterfield & Co., Rock Island, Que.
A. B. Jardine & Co., Ltd., Hespeler, Ont.
Landis Machine Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Murchey Machine & Tool Co., Detroit.
National-Acme Co., Cleveland, Ohio.
Pratt & Whitney Co., Dundas, Ont.
Wells Bros. Co., of Can., Galt, Ont.

DISCS, LEATHER, STEEL
Graton & Knight Mfg. Co., Worcester, Mass.
Swedish Steel & Importing Co., Montreal.

DIRECT CONNECTED UNITS
MacGovern & Co., Montreal, Que.

DRAFT, MECHANICAL
W. H. Banfield & Sons, Toronto.
Butterfield & Co., Rock Island, Que.
Can. Blower & Forge Co., Kitchener.
A. B. Jardine & Co., Hespeler, Ont.
Pratt & Whitney Co., Dundas, Ont.

DRAWING
Henry Hope & Sons, Ltd., Peterboro, Ont.

DRESSERS, GRINDING AND EMERY WHEEL
Can. Desmond-Stephan Mfg. Co., Hamilton
Wheel Trueing Tool Co., Windsor, Ont.
Williams & Wilson, Limited, Montreal

DRILL PRESSES
Aurora Tool Works, Aurora, Ind.
W. F. & John Barnes Co., Rockford.
Can. Blower & Forge Co., Kitchener.
Canada Machinery Corp., Galt, Ont.
Foss Mchy. & S'ply Co., G. F., Montreal.
Garlock-Walker Machinery Co., Toronto
Garvin Machine Co., New York.
A. B. Jardine & Co., Ltd., Hespeler, Ont.
Niles-Bement-Pond Co., New York.
U. S. Mach. Tool Co., Cincinnati, Ohio.
A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

DRILL RODS
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Kayser-Ellison & Co., Ltd., Montreal.
Marshall, Son & Bunney, Toronto.
Norton, Ralph B., Agent, Montreal.
Swedish Steel & Importing Co., Ltd., Montreal.

DRILLING MACHINES, GANG
Barnes, W. F. & John, Co., Rockford, Ill.
Bilton Mach. Tool Co., Bridgeport, Conn
Canada Machinery Corp., Galt, Ont.
Silver Mfg. Co., Salem, Ohio.
Williams & Wilson, Ltd., Montreal, Que.

DRILLING MACHINES, LOCOMOTIVE AND MULTIPLE SPINDLE
John Bertram & Sons Co., Dundas.
Bilton Mach. Tool Co., Bridgeport, Conn.
Can. Blower & Forge Co., Kitchener, Ont
Canada Machinery Corp., Galt, Ont.
Can. Fairbanks-Morse Co., Montreal.
Foss Mchy. & S'ply Co., G. F., Montreal.
Fox Machine Co., Jackson, Mich.
Garlock Walker Mach. Co., Toronto.
Garvin Machine Co., New York.
Hoefer Mfg., Co., Freeport, Ill.
Henry & Wright Mfg. Co., Hartford, Conn
A. B. Jardine & Co., Hespeler, Ont.
Landis Tool Co., Waynesboro, Pa.
Nat. Automatic Tool Co., Richmond, Ind.
Niles-Bement-Pond Co., New York.
Rockford Drilling Mach Co., Rockford, Ill

DRILLING MACHINES, RADIAL AND TURRET
John Bertram & Sons Co., Dundas.
Canadian Fairbanks-Morse Co., Montreal.
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Machinery Co., Toronto.
Henry & Wright Mfg. Co., Hartford,
Landis Tool Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Williams & Wilson, Limited, Montreal.

DRILLING MACHINES, SENSITIVE
Bilton Mach. Tool Co., Bridgeport, Conn.
W. F. & John Barnes Co., Rockford, Ill.
Canadian Fairbanks-Morse Co., Montreal.
Canadian Machinery Corp., Galt, Ont.
Geo. F. Foss Mch. & S'ply Co., Montreal
Garlock-Walker Mach. Co., Toronto, Ont.
Henry & Wright Mfg. Co., Hartford, Conn.
Landis Tool Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
United States Mach. Tool Co., Cincinnati
Williams & Wilson, Limited, Montreal.

DRILLING MACHINES, UPRIGHT AND HORIZONTAL
Aurora Tool Works, Aurora, Ind.
Blomquist-Eck Mach. Co., Cleveland, O.
John Bertram & Sons Co., Dundas.
Garlock-Walker Mach. Co., Toronto, Ont
Can. Blower & Forge Co., Kitchener.
Canada Mach. Corp., Galt, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Fry's (London), Ltd., London, Eng.
Garlock-Walker Mach. Co., Toronto, Ont.
Hoefer Mfg. Co., Freeport, Ill.
A. B. Jardine & Co., Hespeler, Ont.
Landis Tool Co., Waynesboro, Pa.
R. McDougall Co., Galt.
Nat. Automatic Tool Co., Richmond, Ind.
Rockford Drilling Mach. Co., Rockford, Ill
Niles-Bement-Pond Co., New York.
Silver Mfg. Co., Salem, Ohio.
A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

DRILLING MACHINES, SPECIAL
Hoefer Mfg. Co., Freeport, Ill.

DRILLING MACHINES, WALL RADIAL
Lynd-Farquhar Co., Boston, Mass.
Wickes Bros., Saginaw, Mich.

DRILLING POSTS
Aikenhead Hardware Co., Toronto, Ont.
Keystone Mfg. Co., Buffalo, N.Y.
Rice Lewis & Son, Toronto, Ont.
Silver Mfg. Co., Salem, Ohio.

DRILLS, BENCH
Aikenhead Hardware Co., Toronto.
W. F. & John Barnes Co., Rockford, Ill
Can. Blower & Forge Co., Kitchener.
Can. Fairbanks-Morse Co., Montreal.
Geo. F. Foss Mch. & S'ply Co., Montreal
Fry's (London), Ltd., London, England
Garlock-Walker Machinery Co., Toronto.
Pratt & Whitney Co., Dundas, Ont.
Rice Lewis & Son, Toronto, Ont.
U.S. Electrical Tool Co., Cincinnati, O.
Williams & Wilson, Ltd., Montreal, Que.

DRILLS, CENTRE
Aikenhead Hardware Co., Toronto, Ont.
Cleveland Twist Drill Co., Cleveland.
Morrow Screw & Nut Co., John, Ingersoll
Morse Twist Drill & Machine Co., New Bedford, Mass.
Rice Lewis & Son, Toronto, Ont.
Wilt Twist Drill Co., of Can., Walkerville
Williams & Wilson, Ltd., Montreal, Que.

DRILLS, BLACKSMITH AND BIT STOCK
Aikenhead Hardware Co., Toronto, Ont.
Can. Blower & Forge Co., Kitchener.
Cleveland Twist Drill Co., Cleveland.
Geo. F. Foss Mch. & S'ply Co., Montreal
A. B. Jardine & Co., Hespeler, Ont.
Morrow Screw & Nut Co., John, Ingersoll
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Rice Lewis & Son, Toronto, Ont.
Wilkinson & Kompass, Hamilton, Ont.
Wilt Twist Drill Co. of Can., Walkerville

DRILLS, CARBON
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Marshall, Son & Bunney, Toronto.
John Morrow Screw & Nut Co., Ingersoll

DRILLS, ELECTRIC, PORTABLE
Aikenhead Hardware Co., Toronto, Ont.
Can. Blower & Forge Co., Kitchener.
Boker & Co., Inc., H., Montreal, Que.
Cincinnati Electrical Tool Co., Cincinnati
Geo. F. Foss Mch. & S'ply Co., Montreal
Independent Pneumatic Tool Co., Chicago.
Niles-Bement-Pond Co., New York.
Pilot Steel & Tool Co., Montreal, Que.
Prest-O-Lite Co., Inc., Toronto, Ont.
U. S. Electrical Tool Co., Cincinnati, O.
A. R. Williams Mach. Co., Toronto.
Wilkinson & Kompass, Hamilton, Ont.
Williams & Wilson, Ltd., Montreal, Que.

DRILLS, EMERY
Garlock-Walker Mach. Co., Toronto, Ont.

DRILLS, HIGH SPEED TWIST
Aikenhead Hardware Co., Toronto, Ont.
Armstrong-Whitworth of Can., Montreal.
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Butterfield & Co., Rock Island, Que.
Cleveland Twist Drill Co., Cleveland.
Canadian Fairbanks-Morse Co., Montreal
H. A. Drury Co., Montreal.
Geo. F. Foss Mch. & S'ply Co. Montreal
McKenna Brothers, Pittsburgh, Pa.
Marshall, Son & Bunney, Toronto.
Morrow Screw & Nut Co., John, Ingersoll, Ont.
Morse Twist Drill & Machine Co., New Bedford, Mass
W. F. & John Barnes Co., Rockford, Ill
Plewes, Ltd., Winnipeg, Man.
Pratt & Whitney Co., Dundas, Ont.
Rice Lewis & Son, Toronto, Ont.
Standard Machy. & Supplies, Montreal.
Taylor J. A. M., Stair Bldg., Toronto.
Whitman & Barnes Co., St. Catharines.
Wilt Twist Drill Co. of Can., Walkerville
Wilkinson & Kompass, Hamilton, Ont.
Williams & Wilson, Ltd., Montreal, Que

DRILLS, OIL TUBE
Cleveland Twist Drill Co., Cleveland.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rice Lewis & Son, Toronto, Ont.

DRILLS, PNEUMATIC
Can. Ingersoll-Rand Co., Montreal, Que.
Cleveland Pneumatic Tool Co., Toronto.
Independent Pneumatic Tool Co., Chicago.
Niles-Bement-Pond Co., New York.
Williams & Wilson, Limited, Montreal.

DRILLS, PNEUMATIC CORNER
Can. Ingersoll-Rand Co., Montreal, Que.
Cleveland Pneumatic Tool Co. of Canada, Toronto
Garlock-Walker Machinery Co., Toronto.
Independent Pneumatic Tool Co., Chicago.

DRILLS, RATCHET AND HAND
Aikenhead Hardware Co., Toronto, Ont.
Armstrong Bros. Tool Co., Chicago, Ill.
Can. Blower & Forge Co., Kitchener, Ont.

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PHOTOSTATS
Commercial Camera Co., Providence, R.I.

PIPE RIVETED STEEL
Toronto Iron Works, Ltd., Toronto.

PIERCING
Ohio Machine Co., Grand Rapids, Mich.

PIPE CUTTERS, ROLLING
Curtis & Curtis Co., Bridgeport, Conn.
Greenfield Tap & Die Corp., Greenfield.
Hall & Sons, Ltd., John H., Brantford.
Wells Bros. Co. of Canada, Galt, Ont.

PIPE TOOLS AND DIES
Greenfield Tap & Die Corp., Greenfield.
Wells Bros. of Canada, Galt, Ont.

PIPE CUTTERS AND REAMERS
Greenfield Tap & Die Corp., Greenfield.
Wells Bros. of Canada, Galt, Ont.

PIPE STOCKS AND THREADERS
Greenfield Tap & Die Corp., Greenfield.
Wells Bros. of Canada, Galt, Ont.

PIPE TAPS AND VISES
Greenfield Tap & Die Corp., Greenfield.
Wells Bros. of Canada, Galt, Ont.

PIPE WRENCHES
Greenfield Tap & Die Corp., Greenfield.
Wells Bros. of Canada, Galt, Ont.

PISTON RODS, ROUGH TURNED
General Steel Co., Milwaukee, Wis.

PISTON AND PISTON RING MACHINES
National Acme Co., Windsor, Vt.

PLANER BOLTS
Morrow Screw & Nut Co., J., Ingersoll, Ont

PLANER JACKS
Armstrong Bros. Tool Co., Chicago.

PLANERS, STANDARD AND ROTARY
Betts Machine Co., Rochester, N.Y.
Bertram & Sons Co., John, Dundas.
Ohio Machine Co., Grand Rapids, Mich.
Canada Machinery Corp., Galt, Ont.
Can. Fairbanks-Morse Co., Montreal.
Foss Mchy. & Sply Co., G. F., Montreal.
Gardner & Son, Robt., Montreal.
Garlock Walker Machinery Co., Toronto.
Garvin Machine Co., New York.
Morton Mfg. Co., Muskegon Heights, Mich
Niles-Bement-Pond Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Williams & Wilson, Ltd., Montreal, Que.

PLANING AND SHAPING MACHINERY
Canada Machinery Corp., Galt, Ont.
Can. Fairbanks-Morse Co., Montreal.
Foss Mchy. & Sply Co., G. F., Montreal.
Garlock-Walker Machinery Co., Toronto.
Garvin Machine Co., New York.
Niles-Bement-Pond Co., New York.
Williams Machy. Co., A. R., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

PLANER-SHAPER, COMBINED OPEN SIDE
Lynd-Farquhar Co., Boston.
Williams & Wilson, Ltd., Montreal, Que.

POWER HAMMERS
Quickwork Co., St. Marys, Ohio.

PLANING MILL EXHAUSTERS
Can. Blower & Forge Co., Kitchener, Ont.
MacGowern & Co., Montreal, Que.
Niles-Bement-Pond Co., New York.

PLIERS
Aikenhead Hardware Co., Toronto.
Can. Billings & Spencer, Ltd., Welland.
Peck, Stow & Wilcox Co., Southington, Ct.
Rice Lewis & Son, Toronto, Ont.

PNEUMATIC TOOLS
Can. Ingersoll-Rand Co., Montreal, Que.
Cleveland Pneumatic Tool Co., Can., Toronto.
Curtis Pneumatic Machy. Co., St. Louis.
Garlock-Walker Machy. Co., Toronto.
Int. Mach. & Supply Co., Ltd., Montreal.
Independent Pneumatic Tool Co., Chicago.

POWER CRANES, HAND
MacKinnon Steel Co., Sherbrooke, Que.

POLISHING MACHINES
Coil Smith Machine Co., Hamilton, Ont.
Williams & Wilson, Ltd., Montreal, Que.

POLISHING PLATES
Greenfield Tap & Die Corp., Greenfield.
Wells Bros. of Canada, Galt, Ont.
Williams & Wilson, Ltd., Montreal, Que.

POWER HOUSE CONVEYORS
Can. Link-Belt Co., Toronto, Ont.
Morris Crane & Hoist Co., Ltd., Herbert, Niagara Falls, Ont.

POWER TRANSMISSION MCHY.
Williams & Wilson, Ltd., Montreal, Que.

PRESSED STEEL PARTS
New Ball Bearing Co., Ltd., Toronto.

PRESSERS, ARBOR
Atlas Press Co., Kalamazoo, Mich.
Metalwood Mfg. Co., Detroit, Mich.
Williams & Wilson, Ltd., Montreal, Que.

PRESSES, BROACHING, FORGING AND FLANGING
Atlas Press Co., Kalamazoo, Mich.
Bliss Co., E. W., Brooklyn, N.Y.
Metalwood Mfg. Co., Detroit, Mich.
Toledo Machine & Tool Co., Toledo.
Steel Co., D. H., Buffalo, N.Y.
Williams & Wilson, Ltd., Montreal, Que.

PRESSES, CAM, TOGGLE, EYELET
Bacal Machine Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N.Y.
Consolidated Press Co., Hastings, Mich.
Toledo Machine & Tool Co., Toledo.
Stoll Co., D. H., Buffalo, N.Y.
Williams & Wilson, Ltd., Montreal, Que.

PRESSES, FILTER
Perrin, Ltd., William R., Toronto.
Smalley General Co., Inc., Bay City, Mich.

PRESSES, PNEUMATIC
Metalwood Mfg. Co., Detroit, Mich.
Toledo Machine & Tool Co., Toledo.

PRESSES, DROP AND FORGING
Bamfield & Son, W. H., Toronto.
Bliss Co., E. W., Brooklyn, N.Y.
Brown, Boggs Co, Ltd., Hamilton.
Can. Fairbanks-Morse Co., Montreal.
Niles-Bement-Pond Co., New York.
Perrin, Ltd., William R., Toronto.
Stoll Co., D. H., Buffalo, N.Y.
Toledo Machine & Tool Co., Toledo.
Williams & Wilson, Ltd., Montreal, Que.

PRESSES, HYDRAULIC
Bertram & Sons Co., John, Dundas.
Metalwood Mfg. Co., Detroit, Mich.
Niles-Bement-Pond Co., New York.
Perrin, Ltd., William R., Toronto.
Toledo Machine & Tool Co., Toledo.
Stoll Co., Inc., D. H., Buffalo, N.Y.
Standard Machy. & Supplies, Montreal.
West Tire Setter Co., Rochester, N.Y.
Williams Machy. Co., A. R., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

PRESSES, BALING
Perrin, Ltd., William R., Toronto.

PRESSES, POWER
Baird Machine Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Ont.
Canada Machinery Corp., Galt, Ont.
Can. Fairbanks-Morse Co., Montreal.
Consolidated Press Co., Hastings, Mich
Garlock-Walker Machinery Co., Toronto.
Perrin, Ltd., William R., Toronto.
Stoll Co., D. H., Buffalo, N.Y.
Toledo Machine & Tool Co., Toledo.
Williams Machy. Co., A. R., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

PRESSES, SPRING FOOT
Bliss Co., E. W., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Ont.
Consolidated Press Co., Hastings, Mich.
Toledo Machine & Tool Co., Toledo.
Williams & Wilson, Ltd., Montreal, Que.

PRESSES, SCREW
Barnes & Co., W. F. & Jno., Rockford, Ill
Bliss Co., E. W., Brooklyn, N.Y.
Perrin, Ltd., William R., Toronto.
Williams & Wilson, Ltd., Montreal, Que

PRESSES, TRIMMING
Bliss Co., E. W., Brooklyn, N.Y.
Canada Machinery Corp., Galt, Ont.
Consolidated Press Co., Hastings, Mich.
Stoll Co., D. H., Buffalo, N.Y.
Williams & Wilson, Ltd., Montreal, Que.

PROPELLERS
Kennedy & Sons, Wm., Owen Sound.

PSYCROMETERS, SLING
Taylor Instrument Co., Rochester, N.Y.

PULLEYS
Algoma Steel Corp., Sault Ste. Marie, Ont
American Pulley Co., Philadelphia.
Baird Machine Co., Bridgeport, Conn.
Bernard Industrial Co., Fortierville, Que.
Brown & Sharpe Mfg. Co., Providence.
Can. Fairbanks-Morse Co., Montreal.
Ford-Smith Machine Co., Hamilton, Ont.
Kennedy & Sons, Ltd., W., Owen Sound.
Positive Clutch & Pulley Works Ltd., Toronto.
Standard Mach. & Supplies, Montreal.
Wilson & Co., J. C., Belleville, Ont.
Williams Machy. Co., A. R., Toronto.
Williams & Wilson, Ltd., Montreal, Que

PULLEYS, STEEL SASH, STEEL BELT
American Pulley Co., Philadelphia, Pa.

PULLEYS, FRICTION, CLUTCH
American Pulley Co., Philadelphia, Pa.
Baird Machine Co., Bridgeport, Conn.
Bernard Industrial Co., A., Fortierville, Q
Can. Link-Belt Co., Toronto, Ont.
Carlyle Johnson Mch. Co., Manchester, Ct.
Positive Clutch & Pulley Works, Toronto.
Jones & Glassco, Montreal.
Williams & Wilson, Ltd., Montreal, Que.

PULP MILL MACHINERY
MacKinnon Steel Co., Sherbrooke, Que.

PUMPS, CENTRIFUGAL
Bowser & Co., Inc., S. F., Toronto.
Can. Blower & Forge Co., Kitchener, Ont.
Can. Dayton Rand Co., Montreal, Que.
Darling Bros., Ltd., Montreal, Que.
Pratt & Whitney Co., Dundas, Ont.
Williams & Wilson, Ltd., Montreal, Que.

PUMPS, FUEL OIL
Bowser & Co., Inc., Toronto, Ont.
Darling Bros., Ltd., Montreal, Que.
Trahern Pump Co., Rockford, Ill.

PUMPS, GEARED
Darling Bros., Ltd., Montreal, Que.

PUMPS, HIGH PRESSURE
Perrin, Ltd., William R., Toronto.

PUMPS, HYDRAULIC
Garlock Walker Machinery Co., Toronto.
Darling Bros., Ltd., Montreal, Que.
Metalwood Mfg. Co., Detroit, Mich.
Perrin, Ltd., William R., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

PUMPS, LUBRICATING, OIL STORAGE
Bowser & Co., Inc., S. F., Fort Wayne.

PUMPS, RUBBER CEMENT
Bowser & Co., Inc., S. F., Fort Wayne.

PUMPS, KEROSENE, OIL, SELF-MEASURING
Bowser & Co., Inc., S. F., Fort Wayne.

PUMPS, LUBRICANT, OIL, WATER
Darling Bros., Ltd., Montreal, Que.
Fry's (London), Ltd., London, England.
Trahern Pump Co., Rockford, Ill.

PUMPS, SUD
Fry's (London), Ltd., London, England.

PUMP LEATHERS
Graton & Knight Mfg. Co., Worcester.

PUNCHES AND DIES
Atkins & Co., Ltd., Wm., Sheffield, Eng.
W. H. Banfield & Sons, Toronto.
E. W. Bliss Co, Brooklyn, N.Y.
Boker & Co., Inc., H., Montreal, Que.
Brown, Boggs Co., Ltd., Hamilton, Can.
Can. Blower & Forge Co., Kitchener, Ont.
Can. Fairbanks-Morse Co., Montreal.
Gardner & Son, Robert, Montreal.
A. B. Jardine & Co., Hespeler, Ont.
Marshall, Son & Blunney, Toronto.
Marten Machine Co., Hamilton, Ont.
Peck, Stow & Wilcox Co., Southington, Ct.
Pilot Steel & Tool Co., Montreal, Que.
Pratt & Whitney Co., Dundas, Ont.
Stoll Co., D. H., Buffalo, N.Y.
Toledo Machine & Tool Co., Toledo, O.
Williams & Wilson, Ltd., Montreal, Que.

PUNCHES, HAND
Peck, Stow & Wilcox Co., Southington, Ct.

PUNCHES, POWER
John Bertram & Sons Co., Dundas, Ont.
E. W. Bliss Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd, Hamilton, Ont.
Canada Machinery Corp., Galt, Ont.
Consolidated Press Co., Hastings, Mich.
Garlock-Walker Machinery Co., Toronto.
A. B. Jardine & Co., Hespeler, Ont.
Long & Allstatter, Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
D. H. Stoll Co., Buffalo, N.Y.
Wickes Bros., Saginaw, Mich.
Williams & Wilson, Ltd., Montreal, Que.

PUNCHING MACHINES, HORIZONTAL
Bertrams, Ltd., Edinburgh, Scotland.
Bertrams & Sons, John, Dundas, Ont.
Canada Machinery Corp., Galt, Ont.
E. W. Bliss Co., Brooklyn, N.Y.
Brown, Boggs Co, Ltd., Hamilton, Ont.
Garlock-Walker Mach'y. Co., Toronto.
Niles-Bement-Pond Co., New York.
Wickes Bros., Saginaw, Mich.
Williams & Wilson, Ltd., Montreal, Que.

PYROMETERS
Bristol Co., Waterbury, Conn.
Shore Instrument & Mfg. Co., New York.
Taylor Instrument Co., Rochester, N.Y.

QUARTERING MACHINES
Bertram & Sons, John, Dundas, Ont.
Niles-Bement-Pond Co., New York.

RAIL BENDERS
Algoma Steel Corp., Sault Ste. Marie, O.
Niles-Bement-Pond Co., New York.

RAILROAD TOOLS
Can. Fairbanks-Morse Co., Montreal.
Garlock-Walker Machinery Co., Toronto.
Niles-Bement-Pond Co., New York.
Williams & Wilson, Ltd., Montreal, Que.

RASPS
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Marshall, Son & Bunney, Toronto.
John Morrow Screw & Nut Co., Ingersoll.

RATCHETS
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Keystone Mfg. Co., Buffalo, N.Y.
Marshall, Son & Bunney, Toronto.

RAWHIDE PINIONS (See Gears)

REAMERS, ADJUSTABLE
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Greenfield Tap & Die Corp., Greenfield.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Plewes, Ltd., Winnipeg, Man.
Pratt & Whitney Co., Dundas, Ont.
The Kelly Reamer Co., Cleveland, O.
J. A. M. Taylor, 318 Stair Bldg., Toronto.
Standard Mach & Supplies, Montreal.
Wells Bros. of Can., Galt, Ont
Whitman & Barnes Co., St. Catharines.

REAMERS, BRIDGE, EXPANDING AND HIGH SPEED
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Aikenhead Hardware Co., Toronto.
H. Boker & Co., Inc., Montreal, Que.
Butterfield & Co., Rock Island, Que.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Gisholt Machine Co., Madison, Wis.
Illinois Tool Works, Chicago, Ill.
Marshall, Son & Bunney, Toronto.
Morrow Screw & Nut Co., J., Ingersoll, Ont
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pilot Steel & Tool Co., Montreal, Que.
Pratt & Whitney Co., Dundas, Ont.

REAMERS, STEEL TAPER AND SELF-FEEDING
Butterfield & Co., Rock Island, Que.
Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Illinois Tool Works, Chicago, Ill.
A. B. Jardine & Co., Hespeler, Ont.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Dundas, Ont.

REAMERS, CHUCKING
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Greenfield Tap & Die Corp., Greenfield.
Marshall, Son & Bunney, Toronto.
J. Morrow Screw & Nut Co., Ingersoll, Ont.
Wells Bros. of Canada, Galt, Ont.

REAMERS, HAND
Greenfield Tap & Die Corp., Greenfield.
J. Morrow Screw & Nut Co., Ingersoll, Ont.
Wells Bros. of Can., Galt, Ont.

REAMERS, PIN
Greenfield Tap & Die Corp., Greenfield.
Morrow Screw & Nut Co., John, Ingersoll.
Wells Bros. of Can., Galt, Ont.

REAMER FLUTING MACHINES
Garvin Machine Co., New York.

REAMING MACHINES, PNEUMATIC
Cleveland Pneumatic Co. of Can., Toronto
Garlock-Walker Machinery Co., Toronto.

RECORDING INTRUMENTS
Bristol Co., Waterbury, Conn.
Gisholt Machine Co., Madison, Wis.
Taylor Instrument Co., Rochester, N.Y.

REELS, WIRE AND TEXTILE MFG.
American Pulley Co., Philadelphia, Pa.

REGULATORS, AUTOMATIC
Electric Steels & Metals, Ltd., Welland.

REGULATORS, PRESSURE, TEMPERATURE
Can. Fairbanks-Morse Co., Montreal.
Taylor Instrument Co., Rochester, N.Y.

RESPIRATORS
Strong, Kennard & Nutt Co., Cleveland.

RIVETS.
Aikenhead Hardware Co., Toronto, Ont.
Parmenter & Bulloch Co., Gananoque.
Rice, Lewis & Son, Toronto.
Steel Co. of Canada, Ltd., Hamilton.

RIVETERS, PNEUMATIC, HYDRAULIC, HAMMER, COMPRESSION
Can. Fairbanks-Morse Co., Montreal.
Can. Ingersoll-Rand Co., Montreal.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Garlock-Walker Machinery Co., Toronto.
Independent Pneumatic Tool Co., Chicago.
Niles-Bement-Pond Co., New York.

RIVETING MACHINES, ELASTIC, ROTARY BLOW
Grant Mfg. & Machine Co., Bridgeport.
High-Speed Hammer Co., Rochester.
Williams & Wilson, Ltd., Montreal.
F. B. Shuster Co., New Haven, Conn.

ROAD BUILDING EQUIPMENT
Can. Ingersoll-Rand Co., Ltd., Sherbrooke.

RODS, ROPE AND SPRING
General Steel Co., Milwaukee.
Page Steel & Wire Co., Adrian, Mich.

RODS, PURE NICKEL, MONEL METAL, NICHROME
Can. Driver-Harris Co., Ltd., Walkerville.

ROLLER CHAINS
Can. Link-Belt Co., Toronto.
Jones & Glassco, Montreal.

ROLLS, BENDING, STRAIGHTENING
John Bertram & Sons Co., Dundas.
Brown, Boggs Co., Ltd., Hamilton.
Can. Machinery Corp., Galt, Ont.
Garlock-Walker Machinery Co., Toronto.
Niles-Bement-Pond Co., New York.
Toledo Machine & Tool Co., Toledo, O.
Williams & Wilson, Ltd., Montreal, Que.

ROPE, GALX, MONEL METAL, BRONZE, TILLER AND SASH CORD
Can. Driver-Harris Co., Ltd., Walkerville.

ROTARY SHEARS
The Quickwork Co., St. Mary's, Ohio.

Landis Bros. Co., Waynesboro, Pa.
LeBlond Mch. Tool Co., R. K., Cincinnati
Norton Grinding Co., Worcester, Mass.
Pratt & Whitney Co., Dundas, Ont.
Wells Bros. of Can., Galt, Ont.
Williams & Wilson, Ltd., Montreal.

GRINDERS, DIE AND CHASER

Landis Machine Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
National Acme Co., Cleveland, Ohio.

GRINDERS, DISK

Armstrong Bros. Tool Co., Chicago, Ill.
Ford Smith Mach. Co., Hamilton.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., Worcester, Mass.

GRINDERS, DRILL

Aikenhead Hardware Co., Toronto.
Fess Mchy. & S'ply Co., G. F., Montreal.
Garvin Machine Co., New York.
Greenfield Tap & Die Corp., Greenfield.
United States Elec. Tool Co., Cincinnati.
Wells Bros. of Canada, Galt, Ont.
Williams & Wilson, Ltd., Montreal.

GRINDERS, CYLINDER, INTERNAL

Brown & Sharpe Mfg. Co., Providence, R.I.
Fess Mchy. & S'ply Co., G. F., Montreal.
Greenfield Machine Co., Greenfield, Mass.
Heald Machine Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Norton Grinding Co., Worcester, Mass.
Williams & Wilson, Ltd., Montreal.

GRINDERS, PORTABLE, ELECTRIC, HAND, TOOL POST, FLOOR AND BENCH

Baird Machine Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R.I.
Cincinnati Electrical Tool Co., Cincinnati.
Ford-Smith Mach. Co., Hamilton, Ont.
Wisconsin Electric Co., Inc., Racine, Wis.
Fess Mchy. & S'ply Co., G. F., Montreal.
Grant M'f'g & Mach. Co., Bridgeport, Conn.
Garlock-Walker Machinery Co., Toronto.
Greenfield Machine Co., Greenfield, Mass.
Independent Pneumatic Tool Co., Chicago.
United States Elec. Tool Co., Cincinnati.
Williams Machy. Co., A. R., Toronto.
Williams & Wilson, Ltd., Montreal.
Wilkinson & Kompass, Hamilton, Ont.

GRINDERS, HOLE, HOLE AND FACE AND DEEP HOLE

Bryant Chucking Grinder Co., Springfield, Vermont.

GRINDERS, PNEUMATIC

Can. Ingersoll-Rand Co., Montreal.
Cleveland Pneumatic Tool Co., Toronto.
Garlock-Walker Machinery Co., Toronto.
Independent Pneumatic Tool Co., Chicago.
MacGovern & Co., Montreal, Que.

GRINDERS, ROTARY SURFACE

Bristol Machine Tool Co., Bristol, Conn.

GRINDERS, TOOL AND HOLDER

Armstrong Bros. Tool Co., Chicago.
W. F. & John Barnes Co., Rockford, Ill.
Blake & Johnson Co., Waterbury, Conn.
Blount, & Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R.I.
Ford-Smith Machine Co., Hamilton, Ont.
Greenfield Machine Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Greenfield.
National-Acme Co., Cleveland, Ohio.
Tabor Mfg. Co., Philadelphia, Pa.
Wells Bros. of Canada, Galt, Ont.

GRINDERS, UNIVERSAL, PLAIN

Modern Tool Co., Erie, Pa.
Norton Grinding Co., Worcester, Mass.
Williams & Wilson, Ltd., Montreal.

GRINDERS, VERTICAL, SURFACE

Brown & Sharpe Mfg. Co., Providence, R.I.
Can. Fairbanks-Morse Co., Montreal.
Heald Machine Co., Worcester, Mass.
Pratt & Whitney Co., Dundas, Ont.
Gisholt Machine Co., Madison, Wis.
Norton Grinding Co., Worcester, Mass.
Williams & Wilson, Ltd., Montreal.

GRINDING AND POLISHING MACHINES, PORTABLE, PNEUMATIC AND SPRING FRAME

Can. Fairbanks-Morse Co., Montreal.
Cincinnati Elec. Tool Co., Cincinnati, O.
Ford-Smith Mach. Co., Hamilton, Ont.
Gardner & Son, Robt., Montreal.
Garvin Machine Co., New York.
Garlock-Walker Machinery Co., Toronto.
Greenfield Machine Co., Greenfield, Mass.
Hall & Sons, John H., Brantford, Ont.
LeBlond Mch. Tool Co., R. K., Cincinnati
Niles-Bement-Pond Co., New York, N.Y.
Norton Grinding Co., Worcester, Mass.
Wisconsin Electric Co., Racine, Wiss.
Williams & Wilson Ltd., Montreal.

GRINDING MACHINES, CAR WHEEL, CUTTER, CYLINDRICAL, CRANKSHAFT

Norton Grinding Co., Worcester, Mass.

GRINDING WHEELS

Aikenhead Hardware Co., Toronto, Ont.
Brantford Emery Wheel Co., Brantford
Can. Fairbanks-Morse Co., Montreal.
Ford-Smith Machine Co., Hamilton, Ont.
Fess Mchy. & S'ply. Co., G. F., Montreal.
Norton Co., Worcester, Mass.

GRIT, ANGULAR

Pittsburgh Crushed Steel Co., Pittsburgh.

GUARDS, WINDOW AND MACHINE

Canada Machinery Corp., Galt, Ont.
Canada Wire & Iron Goods Co., Hamilton.
Dominion Wire & Iron Works, London, Ont.
Page Steel & Wire Co., Adrian, Mich.
Strong, Kennard & Nutt Co., Cleveland.

HANDLES, BALANCE, CRANK AND MACHINE

Williams & Co., J. H., Brooklyn, N.Y.

HACK SAW BLADES

Aikenhead Hardware Co., Toronto, Ont.
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Roger & Co., Inc., H., Montreal, Que.
Can. Fairbanks-Morse Co., Montreal.
Diamond Saw & Stamping Wks., Buffalo.
Ford-Smith Machine Co., Hamilton, Ont.
Kayser-Ellison & Co., Ltd., Montreal.
Marshall, Son & Bunney, Toronto.
Norton, Ralph R., Agent, Montreal.
Fess Mchy. & S'ply Co., G. F., Montreal.
Peck's (London), Ltd., London, England.
Racine Tool & Machine Co., Racine, Wis.
Plewes, Ltd., Winnipeg, Man.
Peter Steel & Tool Co., Montreal, Que.
Rice Lewis & Son, Toronto, Ont.
Simonds Mfg. Co., Fitchburg, Mass.
L. S. Starrett Co., Athol, Mass.
Standard Machy. & Supplies, Montreal.
Victor Saw Works, Ltd., Hamilton.
Wilkinson & Kompass, Hamilton.
Williams & Wilson, Ltd., Montreal.

HACK SAW FRAMES

Aikenhead Hardware Co., Toronto.
Can. Fairbanks-Morse Co., Montreal.
Ford-Smith Machine Co., Hamilton, Ont.
Garvin Machine Co., New York City.
Victor Saw Works, Hamilton, Ont.
Rice Lewis & Son, Toronto, Ont.
Wilkinson & Kompass, Hamilton, Ont.
Williams & Wilson, Ltd., Montreal.

HACK SAWS, POWER

Aikenhead Hardware Co., Toronto, Ont.
Can. Fairbanks-Morse Co., Montreal.
Diamond Saw & Stamping Wks., Buffalo.
Fess Mchy. & S'ply. Co., G. F., Montreal.
Ford-Smith Machine Co., Hamilton.
Peerless Machine Co., Racine, Wis.
Racine Tool & Mach. Co., Racine, Wis.
Starrett Co., L. S., Athol, Mass.
Victor Saw Works, Hamilton, Ont.
Williams Mach'y Co., A. R., Toronto
Williams & Wilson, Ltd., Montreal.

HAMMERS (DROP), MOTOR AND BELT DRIVEN

Beaudry & Co., Boston, Mass.
Bliss Co., E. W., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton.
Can. Billings & Spencer, Ltd., Welland.
Canada Machinery Corp., Galt, Ont.
High Speed Hammer Co., Rochester, N.Y.
Jardine & Co., A. B., Hespeler, Ont.
Niles-Bement-Pond Co., New York, N.Y.
Toledo Machine & Tool Co., Toledo.
United Hammer Co., Boston, Mass.
Williams & Wilson, Ltd., Montreal.

HAMMERS, HELVE POWER

Canada Machinery Corp., Galt, Ont.
West Tire Setter Co., Rochester, N.Y.
Williams & Wilson, Limited, Montreal.

HAMMERS, CHIPPING, CAULKING, PNEUMATIC

Can. Ingersoll-Rand Co., Montreal, Que.
Garlock-Walker Machinery Co., Toronto.
Independent Pneumatic Tool Co., Chicago.

HAMMERS, MARKING

Matthews & Co., Jas. H., Pittsburgh, Pa.

HAMMERS, NAIL MACHINE

Rice Lewis & Son, Toronto, Ont.
United Hammer Co., Boston, Mass.

HAMMERS, STEAM

Canada Machinery Corp., Galt, Ont.
Niles-Bement-Pond Co., New York.

HAND PLANERS

Oliver Mchry. Co., Grand Rapids, Mich.

HAND LEATHERS OR PADS

Graton & Knight Mfg Co., Montreal.

HANGERS, SHAFT

Algoma Steel Corp., Sault Ste. Marie
Can. General Electric Co., Toronto, Ont.
Chapman Double Ball Bearing Co., Toronto
Gray Ball Bearing Co., Ltd., Toronto.
Baird Machine Co., Bridgeport, Conn.
Can. S K F Co., Toronto, Ont.
Gardner & Son, Robt., Montreal.
Jones & Glassco, Montreal.
Standard Pressed Steel Co., Philadelphia.
Williams & Wilson, Limited, Montreal.

HARDNESS TESTING INSTRUMENTS

Shore Instrument & Mfg. Co., New York

HEAD, AUXILIARY

Hoefer Mfg. Co., Freeport, Ill.

HEATING AND VENTILATING ENGINEERS

Can. Blower & Forge Co., Kitchener, Ont.

HEAT TREATMENT OF STEEL

Gray Ball Bearing Co., Ltd., Toronto.

HEAT GAUGES, HARDENING AND ANNEALING

Shore Instrument & Mfg. Co., New York.

HELMETS, SANDBLAST, AMMONIA

Strong, Kennard & Nutt Co., Cleveland.

HIGH SPEED STEEL

See Steel.

HINGE MACHINERY

Baird Machine Co., Bridgeport, Conn.
Illinois Tool Works, Chicago, Ill.

HINGES

London Bolt & Hinge Wks., London, Ont.

HOBS

Greenfield Tap & Die Co., Greenfield, Mass.
Illinois Tool Works, Chicago, Ill.
Pratt & Whitney Co., Dundas, Ont.
Taylor, J. A. M., 318 Stair Bldg., Toronto.
Wells Bros. of Canada, Galt, Ont.

HOISTS, AIR

Can. Ingersoll Rand Co., Ltd., Sherbrooke.
Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.

HOISTS, CHAIN AND PNEUMATIC

Can. Ingersoll-Rand Co., Montreal, Que.
Garlock-Walker Machinery Co., Toronto.
Ford Chain Block & Mfg., Philadelphia.
Independent Pneumatic Tool Co., Chicago.
Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.
Northern Crane Works, Walkerville, Ont.
Wright Mfg. Co., Lisbon, Ohio.
Williams & Wilson, Limited, Montreal.

HOISTS, ELECTRICAL

Can. Link-Belt Co., Toronto, Ont.
Dominion Bridge Co., Montreal, Que.
Electric Steels & Metals Ltd., Welland.
Kennedy & Sons, Owen Sound, Ont.
Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.
Northern Crane Works, Walkerville, Ont.
Williams & Wilson, Limited, Montreal.

HOLDERS, STEEL DIE FOR MARKING

Matthews & Co., Jas. H., Pittsburgh, Pa.

HOLDERS, ELECTRIC

Electric Steels & Metals, Ltd., Welland.

HOOKS, BELT LACING

Clipper Belt Lacer Co., Grand Rapids.

HOPPERS

MacKinnon Steel Co., Ltd., Sherbrooke.
Dominion Bridge Co., Montreal, Que.
Toronto Iron Works, Ltd., Toronto, Ont.

HOSE, PNEUMATIC

Cleveland Pneumatic Tool Co. of Canada, Toronto.
Garlock-Walker Machinery Co., Toronto
Independent Pneumatic Tool Co., Chicago
Wells Bros. Co. of Canada, Galt, Ont.

HOSE, ALL KINDS

Int Mach. & Supply Co., Ltd., Montreal.

HOSE, SAND BLAST

Pangborn Corporation, Hagerstown, Md.

HYDRAULIC MACHINERY

Garlock-Walker Machinery Co., Toronto.
Metalwood Mfg. Co., Detroit, Mich.
Niles-Bement-Pond Co., New York.
Perrin, Ltd., William R., Toronto.
West Tire Setter Co., Rochester, N.Y.
Victoria Foundry Co., Ottawa.
Williams & Wilson, Limited, Montreal.

HYDROMETERS, HYGROMETERS, HYGRODEIKS

Taylor Instrument Co., Rochester, N.Y.

INDICATORS, SPEED

Aikenhead Hardware Co., Toronto, Ont.
Brown & Sharpe Mfg. Co., Providence
Starrett Co., L. S., Athol, Mass.

INDEX CENTRES

Dickow, Fred C., Chicago, Ill.
Ford-Smith Machine Co., Hamilton, Ont.
Garvin Machine Co., New York.
Williams & Wilson, Limited, Montreal.

INDICATING INSTRUMENTS

Taylor Instrument Co., Rochester, N.Y.

INGOT METAL

Brown's Copper & Brass Rolling Mills New Toronto, Ont.

INGOTS, STEEL

Nova Scotia Stl. & Coal Co., New Glasgow

INGOTS, FORGING AND ROLLING

Electric Steel & Metals Co., Welland.

INSTRUMENTS, ENGINEERING

Consolidated Optical Co., Toronto.

IRON ORE

Hanna & Co., M. A., Cleveland, O.

IRON SAND

Pittsburgh Crushed Steel Co., Pittsburgh.

IRON, WROUGHT, ROLLED, PIG

Swedish Steel & Impt. Co., Ltd., Montreal

JACKS

Aikenhead Hardware Co., Toronto, Ont.
Can. Fairbanks-Morse Co., Montreal.
Fellows Bros., Ltd., Chadley Heath, Eng.
Morris Crane & Hoist Co., Herbert Niagara Falls, Ont.
Northern Crane Works, Walkerville.
Norton, A. O., Coaticook, Que.
Rice Lewis & Son, Toronto, Ont.
Williams & Wilson, Limited, Montreal.

JACKS, SCREW AND HYDRAULIC

Fellows Bros., Ltd., Chadley Heath, Eng.

JACKS, PIT AND TRACK

Canadian Fairbanks-Morse Co., Montreal.
Northern Crane Works, Walkerville.

JAWS, FACE PLATE

Cushman Chuck Co., Hartford, Conn.
Skinner Chuck Co., New Britain, Conn.

JOINTERS

Gray Ball Bearing Co., Ltd., Toronto.

JIGS, TOOLS, ETC.

Brown Engineering Corp., Toronto.
Elliott & Whitehall Mach. & Tool Co., Galt.
Gisholt Machine Co., Madison, Wis.
Homer & Wilson, Hamilton, Ont.
Illinois Tool Works, Chicago, Ill.
Marten Machine Co., Hamilton, Ont.
Toronto Tool Co., Toronto, Ont.

JOURNAL WEDGES

Canada Foundries & Forgings, Welland.

KEY SEATERS

Garlock-Walker Machy. Co., Toronto, Ont.
Garvin Machine Co., New York.
Morton Mfg. Co., Muskegon Heights, M.
A. R. Williams Machy. Co., Toronto.
Williams & Wilson, Ltd., Montreal.

KEYS, MACHINE

Whitney Mfg. Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N.Y.

KILNS

Can. Blower & Forge Co., Kitchener, Ont.
Kennedy & Sons, Wm., Owen Sound, Ont.
MacKinnon Steel Co., Sherbrooke, Que.

KNIFE GRINDERS

Gray Ball Bearing Co., Ltd., Toronto.

LABELS AND TAGS

Matthews & Co., Jas. H., Pittsburgh, Pa.

LABORATORIES, INSPECTION AND TESTING (See Chemists)

LADLES, FOUNDRY

Northern Crane Works, Walkerville.

LACING MACHINES

Clipper Belt Lacer Co., Grand Rapids, M.

LAMPS, ARC, INCANDESCENT

Can. General Electric Co., Toronto, Ont.

LAMPS, TUNGSTEN AND NITRO

Can. General Electric Co., Toronto, Ont.

LAG SCREW GIMLET POINTERS

National Machy. Co., Tiffin, Ohio.

LATHES, CHUCKING

Acme Machine Tool Co., Cincinnati, Ohio
Wood Turret Machine Co., Brazil, Ind.
Williams & Wilson, Limited, Montreal.

LATHE CHUCKS (See Chucks)
LATHE DOGS AND ATTACHMENTS

Armstrong Bros. Tool Co., Chicago.
Curtis & Curtis Co., Bridgeport, Conn.
Hendey Machine Co., Torrington, Conn.
Williams & Co., J. H., Brooklyn, N.Y.

LATHES, AUTOMATIC AND SEMI-AUTOMATIC

Gisholt Machine Co., Madison, Wis.
Wood Turret Machine Co., Brazil, Ind.

LATHES, AXLE

Bridgeford Mach. Tool Works, Rochester.

LATHES, BORING

Bridgeford Mach. Tool Works, Rochester.
Lodge & Shipley, Cincinnati, O.
Williams & Wilson, Ltd., Montreal, Que.

LATHES, PRECISION, BENCH

W. F. & John Barnes Co., Rockford.
J. G. Blount & Co., Everett, Mass.
Canadian Fairbanks-Morse Co., Montreal.
Geo. F. Foss Machy. & Supply Co., Montreal.
Garlock-Walker Machinery Co., Toronto.
Hardinge Bros., Chicago, Ill.
Pratt & Whitney Co., Dundas, Ont.
Seneca Falls Mfg. Co., Seneca Falls, N.Y.
Williams & Wilson, Ltd., Montreal, Que.

LATHES, BRASS

Acme Machine Tool Co., Cincinnati, Ohio.
Hardinge Bros., Chicago, Ill.
Lodge & Shipley, Cincinnati, O.
Wood Turret Machine Co., Brazil, Ind.
Williams & Wilson Ltd., Montreal, Que.

LATHES, ENGINE

Acme Machine Tool Co., Cincinnati, Ohio.
John Bertram & Sons Co., Dundas.
Bridgeford Mach. Tool Wks., Rochester.
Canada Mach'y Corp., Galt, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cisco Machine Tool Co., Cincinnati, Ohio.
Wickes Bros., Saginaw, Mich.
G. F. Foss Mchy. & S'ply Co., Montreal.
Garlock-Walker Machinery Co., Toronto.
Garvin Machine Co., New York.
Gisholt Machine Co., Madison, Wis

Kennedy & Sons, Wm., Owen Sound, Ont.
R. McKechnie Co., Galt.
Miles-Bement-Pond Co., New York.
Smallev-Universal Co., Inc., Bay City, Mich.
Seneca Falls Mfg. Co., Seneca Falls, N.Y.
Standard Machy. & Supplies, Montreal.
Super Tool Co., Sidney, Ohio.
Walcott Lathe Co., Lockport, Mich.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
A. R. Williams Machy. Co., Toronto.
Williams & Wilson, Ltd., Montreal, Que.
Worcester Lathe Co., Worcester, Mass.

LATHES, FOOT POWER

Seneca Falls Mfg. Co., Seneca Falls, N.Y.

LATHES, HORIZONTAL

Wood Turner Machine Co., Brazil, Ind.

LATHES, JOURNAL TRUEING

Bridgeford Mach. Tool Works, Rochester.

LATHES, PATTERNMAKERS'

J. G. Brass Co., Easthampton, Mass.
Cox Machinery Corp., Galt.
Wood Turner Machine Co., Brazil, Ind.
G. F. Foss Machy. & Sply. Co., Montreal.
Garlock-Walker Machy. Co., Toronto, Ont.
Williams & Wilson, Ltd., Montreal, Que.

LATHES, POLISHING

Greenfield Tap & Die Corp., Greenfield.
Wells Bros. of Canada, Galt, Ont.
Williams & Wilson, Ltd., Montreal, Que.

LATHES, SCREW CUTTING

Bertram & Sons Co., John, Dundas, Ont.
Bridgeford Mach. Tool Works, Rochester.
Canada Machinery Corp., Galt, Ont.
Cisco Machine Tool Co., Cincinnati, O.
Foss Machy. & Sply. Co., G. F., Montreal.
Foster Machine Co., Elkhart, Ind.
Garlock-Walker Machy. Co., Toronto, Ont.
Hardinge Bros., Inc., Chicago, Ill.
Hepburn Ltd., John T., Toronto, Ont.
Niles-Bement-Pond Co., New York.
Seneca Falls Mfg. Co., Seneca Falls, N.Y.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Wickes Bros., Saginaw, Mich.
Williams Machy. Co., A. R., Toronto.
Wood Turner Machine Co., Brazil, Ind.
Worcester Lathe Co., Worcester, Mass.
Williams & Wilson, Ltd., Montreal, Que.

LATHES, SPINNING

Bliss Co., E. W., Brooklyn, N.Y.
Williams & Wilson, Ltd., Montreal, Que.

LATHES, TOOL ROOM

Cisco Machine & Tool Co., Cincinnati, O.
Seneca Falls Mfg. Co., Seneca Falls, N.Y.
Worcester Lathe Co., Worcester, Mass.
Williams & Wilson, Ltd., Montreal, Que.

LEAD BURNING

St. Lawrence Welding Co., Montreal.

LEAD BURNING OUTFITS

Turner Brass Works, Sycamore, Ill.

LEATHER STRAPPING

Graton & Knight Mfg. Co., Worcester, M.

LENSES FOR GOGGLES

Standard Optical Co., Geneva, N.Y.

LIDS, SCREW TOP AND HINGE

Can. Winkley Co., Ltd., Windsor, Ont.

LINK BELTING

See Belting, Chain.

LINOLEUM MILL MACHINERY

Bertrams, Ltd., Edinburgh, Scotland.

LOCKERS, STEEL WARDROBE AND STEEL MATERIAL

Canada Wire & Iron Gds. Co., Hamilton.
Dennis Wire & Iron Works, London, Ont.

LUBRICANTS

Cataract Refining & Mfg. Co., Toronto.

LUBRICATING, OIL FILTERING AND CIRCULATING SYSTEMS

Bowser & Co., S. F., Inc., Fort Wayne.

LUBRICATORS

Trabern Pump Co., Rockford, Ill.

LUMBERMEN'S TOOLS

Thos. Pink Co., Ltd., Pembroke, Ont.

MACHINE COUNTER WEIGHTS

Katie Foundry, Galt, Ont.

MACHINERY, CORNER AND BENDING

Peck, Stow & Wilcox, Southington, Conn.

MACHINERY DEALERS

Archibald & Co., Chas. P., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Garlock-Walker Machy. Co., Toronto, Ont.
Foss Machy. & Sply. Co., G. F., Montreal.
Standard Machy. & Supplies, Montreal.
Williams Machy. Co., A. R., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

MACHINERY GUARDS (See Guards)

MANDRELS

Can. Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Jardine & Co., A. B., Hespeler, Ont.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Dundas, Ont.

MARKING DEVICES

Pritchard-Andrews Co. of Can., Ottawa.
Matthews & Co., Jas. H., Pittsburgh, Pa.

MARKING MACHINERY

Brown Bros. Co., Hamilton, Ont.
Foss Machy. & Sply. Co., G. F., Montreal.
Pierce, Wm. R., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

MASKS, WELDING, SMOKE, FUME, GAS, ETC.

Strang, Kennard & Nutt Co., Cleveland.

MEASURING MACHINES

Pratt & Whitney Co., Dundas, Ont.

MEASURES, REGISTERING

Bowser & Co., S. F., Inc., Fort Wayne.

MEASURING TAPES AND RULES

Chesterman & Co., Jas., Sheffield, Eng.

METALLURGISTS

See Chemists.

METAL SAWS

See Saws.

METAL SAWS, POWER

Hoefer Mfg. Co., Freeport, Ill.

METALS

Brown's Copper & Brass Rolling Mills, New Toronto, Ont.
Canada Metal Co., Toronto, Ont.
Rice Lewis & Son, Toronto, Ont.
Standard Machy. & Supplies, Montreal.

METAL, STAMPINGS, SMALL

Can. Winkley Co., Ltd., Windsor, Ont.

METERS, OIL, GASOLINE, KEROSENE, ETC.

Bowser & Co., Inc., S. F., Toronto, Ont.

MICROMETERS

Almond Mfg. Co., Ashburnham, Mass.
Taylor, J. A. M., 313 Starr Bldg., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

MILLS, SAND

Frost Mfg. Co., Chicago, Ill.

MILL MACHINERY

Alexander Fleck, Ltd., Ottawa.
Greenfield Tap & Die Corp., Greenfield.
Wells Bros. of Canada, Galt, Ont.

MILLING ARBORS

Kearney & Trecker Co., Milwaukee, Wis.

MILLING ATTACHMENTS

Becker Milling Machine Co., Boston, Mass.
Bertram & Sons Co., John, Dundas, Ont.
Brown & Sharpe Mfg. Co., Providence.
Canada Machinery Corp., Galt, Ont.
Cincinnati Milling Machine Co., Cincinnati
Ford-Smith Mach. Co., Hamilton, Ont.
Fox Machine Co., Jackson, Mich.
Foss Machy. & Sply. Co., G. F., Montreal.
Hardinge Bros., Inc., Chicago, Ill.
Hendey Mach. Co., Torrington, Conn.
Hinckley Machine Works, Hinckley, Wis.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Taft-Peirce Mfg. Co., Woonsocket, R.I.
Williams & Wilson, Ltd., Montreal, Que.

MILLING MACHINES, AUTOMATIC

Bilton Mach. Tool Co., Bridgeport, Conn.
Betts Machine Co., Rochester, N.Y.
Williams & Wilson, Ltd., Montreal, Que.

MILLING CUTTERS

Atkins & Co., Ltd., Wm., Sheffield, Eng.
Cleveland Milling Machine Co., Cleveland.
Kearney & Trecker Co., Milwaukee, Wis.
Marshall, Son & Bunney, Toronto.
Williams & Wilson, Ltd., Montreal, Que.

MILLING MACHINES, HAND

Bristol Machine Tool Co., Bristol, Conn.

MILLING MACHINES, THREAD

Gisholt Machine Co., Madison, Wis.
Hardinge Bros., Inc., Chicago, Ill.
Gray Ball Bearing Co., Ltd., Toronto.
United States Mach. Tool Co., Cincinnati.
Pratt & Whitney Co., Dundas, Ont.
Williams & Wilson, Ltd., Montreal, Que.

MILLING MACHINES, HORIZONTAL AND VERTICAL

Becker Milling Machine Co., Boston, Mass.
Bristol Machine Tool Co., Bristol, Conn.
Brown & Sharpe Mfg. Co., Providence.
Bertram & Sons Co., John, Dundas, Ont.
Canada Machinery Corp., Galt, Ont.
Ford-Smith Mach. Co., Hamilton, Ont.
Fox Machine Co., Jackson, Mich.
Garlock-Walker Machy. Co., Toronto, Ont.
Gooley & Edlund, Cortland, N.Y.
Hardinge Bros., Inc., Chicago, Ill.
Kearney & Trecker Co., Milwaukee, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
United States Mach. Tool Co., Cincinnati.
Whitney Mfg. Co., Hartford, Conn.
Williams Machy. Co., A. R., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

MILLING MACHINES, PLAIN, BENCH AND UNIVERSAL

Becker Milling Machine Co, Boston, Mass.
Bilton Mach. Tool Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence.
Canada Machinery Corp., Galt, Ont.
Cincinnati Milling Machine Co., Cincinnati
Ford-Smith Mach. Co., Hamilton, Ont.
Foss Machy. & Sply. Co., G. F., Montreal.
Fox Machine Co., Jackson, Mich.
Garlock-Walker Machy. Co., Toronto, Ont.
Garvin Machine Co., New York.
Gooley & Edlund, Inc., Cortland, N.Y.
Hardinge Bros., Inc., Chicago, Ill.
Hendey Machine Co., Torrington, Conn.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati
Niles Bement Pond Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Williams & Wilson, Ltd., Montreal, Que.

MILLING MACHINES, PROFILE

Brown & Sharpe Mfg. Co., Providence.
Can. Fairbanks-Morse Co., Montreal.
Foss Machy. & Sply. Co., G. F., Montreal.
Garlock-Walker Machy. Co., Toronto, Ont.
Garvin Machine Co., New York.
Pratt & Whitney Co., Dundas, Ont.
Williams & Wilson, Ltd., Montreal, Que.

MILLING TOOLS

Aikenhead Hardware Co., Toronto, Ont.
Brown & Sharpe Mfg. Co., Providence.
Ford-Smith Mach. Co., Hamilton, Ont.
Geometric Tool Co., New Haven, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
Rice Lewis & Son, Toronto, Ont.
Tabor Mfg. Co., Philadelphia, Pa.
Williams & Wilson, Ltd., Montreal, Que.

MINE CARS

Can. Fairbanks-Morse Co., Montreal.
Dominion Bridge Co., Montreal, Que.
MacKinnon Steel Co., Sherbrooke, Que.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Dundas, Ont.

MINING MACHINERY

Can. Fairbanks-Morse Co., Montreal.
Williams Machy. Co., A. R., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

MIXERS, SAND

Frost Mfg. Co., Chicago, Ill.

MODEL WORK

Windsor Mach. & Tool Co., Windsor, Ont.

MORTISING MACHINES

Canada Machinery Corp., Galt, Ont.
Garlock-Walker Machy. Co., Toronto, Ont.
Gray Ball Bearing Co., Ltd., Toronto.

MOTORS, ELECTRIC

Can. Fairbanks-Morse Co., Montreal.
Can. General Electric Co., Toronto.
Garlock-Walker Machy. Co., Toronto, Ont.
Lancashire Dynamo & Motor Co., Ltd., Toronto.
MacGovern & Co., Montreal, Que.
Williams Machy. Co., A. R., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

MOTOR SPRINGS

The Dunbar Brothers Co., Bristol, Conn.

MOTORCYCLE FRAME AND FORK

The Dunbar Brothers Co., Bristol, Conn.

MOTORS, PNEUMATIC

Cleveland Pneumatic Tool Co., Toronto.

MULTIPLE INDEX CENTRES

Garvin Machine Co., New York.

MULTI-DRILLING, MULTI-BORING, MULTI-TAPPING MACHINERY,

Nat. Automatic Tool Co., Richmond, Ind.

MUNTZ METAL

Brown's Copper & Brass Roller Mills, New Toronto, Ont.

NAIL SETS

Morrow Screw & Nut Co., J., Ingersoll, Ont

NAIL MACHINERY

Sleeper & Hartley, Inc., Worcester, Mass.

NAME PLATES, BRONZE, ETCHED AND STAMPED

Matthews & Co., Jas. H., Pittsburgh, Pa.
Pritchard-Andrews Co., Ottawa, Ont.
Turner Brass Works, Sycamore, Ill.

NICHROME CASTINGS

Can. Driver-Harris Co., Ltd., Walkerville.

NICKEL

Boker & Co., Inc., H., Montreal, Que.
Pilot Steel & Tool Co., Montreal, Que.

NICKEL SILVER

Brown's Copper & Brass Rolling Mills, New Toronto, Ont.

NICKEL STEEL

See Steel.

NIPPLE HOLDERS

Curtis & Curtis Co., Bridgeport, Conn.

NIPPLE THREADING MACHINES

Hall & Sons, Ltd., John H., Brantford.
Landis Machine Co., Waynesboro, Pa.

NITROGEN

Carter Welding Co., Toronto, Ont.

NUTS, STEEL, CASTELLATED AND COLD PRESSED

Morrow Screw & Nut Co., J., Ingersoll, Ont
Williams & Co., J. H., Brooklyn, N.Y.

NUTS, SEMI-FINISH AND FINISHED

Gait Machine Screw Co., Galt, Ont.
National-Acme Co., Cleveland, Ohio.
Wilkinson & Kompass, Hamilton.

NUT BURRING AND NUT MACHINES (HOT)

National Machy. Co., Tiffin, Ohio.

NUT FACING AND BOLT SHAVING MACHINES

Garvin Machine Co., New York.
National Machinery Co., Tiffin, Ohio.
Victor Tool Co., Waynesboro, Pa.
Williams & Wilson, Ltd., Montreal, Que.

NUT TAPPERS

Bertram & Sons Co., John, Dundas, Ont.
Canada Machinery Corp., Galt, Ont.
Garvin Machine Co., New York.
Hall & Son, J. H., Brantford, Ont.
Jardine & Co., A. B., Hespeler.
Landis Machine Co., Waynesboro, Pa.
National Machinery Co., Tiffin, Ohio.
Williams & Wilson, Ltd., Montreal, Que.

OIL SEPARATORS

Can. Fairbanks-Morse Co., Montreal.

OIL STONES

Aikenhead Hardware Co., Toronto, Ont.
Carborundum Co., Niagara Falls, N.Y.
Norton Co., Worcester, Mass.
Rice Lewis & Son, Toronto, Ont.

OIL STONE GRINDERS

Oliver Machy. Co., Grand Rapids, Mich.

OIL STORAGE SYSTEMS

Bowser & Co., Inc., S. F., Toronto, Ont.

OPENING DIE HEADS

Greenfield Tap & Die Corp, Greenfield.
Wells Bros. of Canada, Galt, Ont.

OPTICAL SUPPLIES

Consolidated Optical Co., Toronto, Ont.

OSCILLATING VALVE GRINDERS (PNEUMATIC)

Cleveland Pneumatic Tool Co. of Canada, Toronto.

OVENS FOR BAKING, BLUING, DRYING, ENAMELING, JAPANNING AND LACQUERING

Brantford Oven & Rack Co., Brantford.

OVEN TRUCKS, STEEL

Brantford Oven & Rack Co., Brantford.
MacKinnon Steel Co., Sherbrooke, Que.

OVENS FOR DRYING, TEMPER AND OXYGEN, ELECTROLYTIC CELLS UNDER TRUCKS

Welding & Supplies Co., Montreal, Que.
Brantford Oven & Rack Co., Brantford.

OXY-ACETYLENE WELDING AND CUTTING AND OUTFITS

Carter Welding Co., Toronto, Ont.
Prest-o-Lite Co., Inc., Toronto, Ont.
St. Lawrence Welding Co., Montreal, Que.
Welding & Supplies Co., Montreal, Que.

PACKINGS, ASBESTOS

Cleveland Wire Spring Co., Cleveland.

PACKINGS, LEATHER, HYDRAULICS, ETC.

Graton & Knight Mfg. Co., Worcester, M.
Perrin, Ltd., William, Toronto.

PANS, WET AND DRY

Frost Mfg. Co., Chicago, Ill.

PAPER MILL CONVEYORS AND DRIVES

Bertrams, Ltd., Edinburgh, Scotland.
Can. Link-Belt Co., Toronto, Ont.
MacKinnon Steel Co., Sherbrooke, Que.

PARTITIONS, WIRE

See Guards

PAPER MILL MACHINERY

Garlock-Walker Machinery Co., Toronto.

PATTERN SHOP EQUIPMENT

Canada Machinery Corp., Galt, Ont.
Oliver Machy. Co., Grand Rapids, Mich.
Fox Machine Co., Jackson, Mich.
Garlock-Walker Machinery Co., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

PATTERN MAKERS' LATHES

See Lathes.

PATENT SOLICITORS

Budden, Hanbury A., Montreal.
Fetherstonhaugh & Co., Ottawa.
Marion & Marion, Montreal.
Ridout & Maybee, Toronto.
Wilson & Co., J. C., Belleville, Ont.
Greenleafs Ltd., Belleville, Ont.
Marten Machine Co., Hamilton, Ont.

PECK CARRIERS FOR POWER PLANTS

Can. Link-Belt Co., Toronto, Ont.

PERFORATED METALS AND ORNAMENTAL IRON GOODS

Canada Wire & Iron Goods Co., Hamilton

PIG IRON

Hanna & Co., M. A., Cleveland, O.
Steel Co. of Canada, Ltd., Hamilton, Ont.

PINS, TAPER

Morrow Screw & Nut Co., J., Ingersoll, Ont

PINS, BELT-LACING

Clipper Belt Lacer Co., Grand Rapids.

PIPE FITTINGS, MALLEABLE AND CAST IRON

International Malleable Iron Co., Guelph.

PIPE CUTTING AND THREADING MACHINES

Butterfield & Co., Rock Island, Que.

BUYERS' DIRECTORY

Canadian Fairbanks-Morse Co., Montreal.
Cincinnati Pneumatic Tool Co., Cincinnati.
[illegible]
[illegible]
A. B. Jardine & Co., Hespeler, Ont.
Morrow Screw & Nut Co., John, Ingersoll, Ont.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
[illegible]
Rice Lewis & Son, Toronto, Ont.
[illegible] Twist Drill Co. of Can., Walkerville.

DRILLS, ROCK
[illegible], Montreal, Que.
Cleveland Pneumatic Tool Co., Toronto.
The Foss Mchy. & Supply Co., Montreal.
A. R. Williams Machy. Co., Toronto.

DRILLS, TRACK
[illegible], Cleveland.
The Foss Mchy. & Supply Co., Montreal.
Morrow Screw & Nut Co., J., Ingersoll, Ont.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
[illegible] Twist Drill Co. of Can., Walkerville.

DRINKING FOUNTAINS, SANITARY
Puro Sanitary Drinking Fountain Co., Haydenville, Mass.

DRIVES, CHAIN
See Belting, Chain.

DRIVING TOOLS
The Thos. Pink Co., Ltd., Pembroke, Ont.

DRY CLEANING SYSTEM
Bowser & Co., Inc., Fort Wayne, Ind.

DRYERS, SAND
Pangborn Corporation, Hagerstown, Md.

DRYING APPLIANCES
Baird Machine Co., Bridgeport, Conn.

DRUM CONTROLS
Elec. Steel & Metals, Ltd., Welland, Ont.

DUMP CARS
Canadian Fairbanks-Morse Co., Montreal.
MacKinnon Steel Co., Sherbrooke, Que.

DUST EXHAUSTER ARRESTER SYSTEM
Pangborn Corporation, Hagerstown, Md.

DUST HANDLING EQUIPMENT
Pangborn Corporation, Hagerstown, Md.

DUST SEPARATORS
Can. Blower & Forge Co., Kitchener, Ont.

DYNAMOS AND ELECTRICAL SUPPLIES
Canadian Fairbanks-Morse Co., Montreal.
Lancashire Dynamo & Motor Co., Ltd., Toronto.
MacGovern & Co., Montreal, Que.
A. R. Williams Machy. Co., Toronto.

ELECTRICAL SUPPLIES
Can. General Electric Co., Toronto, Ont.

ELECTRIC FURNACE
Electric Steel & Metals, Ltd., Welland.
General Steel Co., Milwaukee, Wis.

ELECTRICAL RESISTANCE MATERIALS, NICHROME, KROMORE, CHROMAX, CLIMAX, NICKEL, SILVER, ADVANCE.
Can. Driver-Harris Co., Walkerville, Ont.

ELEVATOR, ENCLOSURES
Volta Mfg. Co., Welland, Ont.
Canada Wire & Iron Goods Co., Hamilton

ELEVATOR WEIGHTS
Katie Foundry, Galt, Ont.

ELEVATORS AND BUCKETS
Can. Link-Belt Co., Toronto, Ont.
Curtis Pneumatic Machy. Co., St. Louis.
Williams & Wilson, Ltd., Montreal, Que.

ELEVATING AND CONVEYING MACHINERY
Can. Link-Belt Co., Toronto, Ont.
Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.
Williams & Wilson, Ltd., Montreal, Que.

EMBOSSING PRESSES
Oliver Machinery Co., Grand Rapids, Mich

EMERY GRINDERS (PNEUMATIC)
Cleveland Pneumatic Tool Co., Toronto.
Ford-Smith Machine Co., Hamilton, Ont.

EMERY AND EMERY WHEELS
Brantford Emery Wheel Co., Brantford, Canada.
The Foss Mchy. & Supply Co., Montreal.
Garvin Machine Co., New York.
Canadian Fairbanks-Morse Co., Montreal.
Canada Emery Wheels Co., Hamilton
Ford Smith Mach. Co., Hamilton, Ont.
Rice Lewis & Son, Toronto, Ont.
Standard Machy. & Supplies, Montreal.
Wilkinson & Kompass, Hamilton, Ont.
Williams & Wilson, Ltd., Montreal, Que.

EMERY WHEEL DRESSINGS
Wheel Trueing Tool Co., Windsor, Ont.

END MILLS
John Morrow Screw & Nut Co., Ingersoll

ENGINES, STEAM, GAS, GASOLINE
Canadian Fairbanks-Morse Co., Montreal.
Johnson Mach. Co., Carlyle, Manchester, Conn.
MacGovern & Co., Montreal, Que.

ENGINES, HORIZONTAL AND VERTICAL
Johnson Mach. Co., Carlyle, Manchester, Conn.
A. R. Williams Machy. Co., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

ENGINES, MARINE
Can. Ingersoll-Rand Co., Sherbrooke, Que.

ENGRAVERS
Pritchard-Andrews Co., Ottawa.

ESCUTCHEON PINS
Parmenter & Bulloch, Gananoque, Ont.

EXHAUST HEADS AND HOODS
Can. Blower & Forge Co., Kitchener, Ont.
Canadian Fairbanks-Morse Co., Montreal.

EXHAUSTERS
Can. Blower & Forge Co., Kitchener, Ont.
Pangborn Corporation, Hagerstown, Md.
Williams & Wilson, Ltd., Montreal, Que.

EXTRACTORS, TAP
Walton Co., The, Hartford, Conn.

EYE BOLTS AND NUTS
Can. Foundries & Forgings, Ltd., Welland, Ont.

EYE PROTECTORS
Standard Optical Co., Geneva, N.Y.
Strong, Kennard & Nutt Co., Cleveland.
Willson & Co., Inc., T. A., Reading, Pa.

FACTORY GATES
Page Steel & Wire Co., Adrian, Mich.

FANS
Baird Machine Co., Bridgeport, Conn.
Can. Blower & Forge Co., Kitchener, Ont.

FENCING, WIRE
Page Steel & Wire Co., New York, N.Y.
Williams & Wilson, Ltd., Montreal, Que.

FENCE, IRON AND FACTORY
Can. Wire & Iron Goods, Hamilton, Ont.
Page Steel & Wire Co., Adrian, Mich.

FERRO-TUNGSTEN
Vanadium-Alloys Steel Co., Pittsburgh, Pa.

FILES
Aikenhead Hardware Co., Toronto, Ont.
Atkins & Co., Wm., Sheffield, Eng.
Ingersoll File Co., Ltd., Ingersoll, Ont.
Morrow Screw & Nut Co., J., Ingersoll, Ont.
Marshall, Son & Bunney, Toronto, Ont.
Nicholson File Co., Port Hope, Ont.
Rice Lewis & Son, Toronto, Ont.
Standard Machy. & Supplies, Montreal.
Simonds Mfg. Co., Fitchburg, Mass.
Wilkinson & Kompass, Hamilton, Ont.

FILTERING AND CIRCULATING SYSTEMS FOR LUBRICATING OIL
Bowser & Co., S. F., Fort Wayne, Ind.
Can. Wire & Iron Goods, Hamilton, Ont.

FIRST AID CABINETS
Strong, Kennard & Nutt Co., Cleveland.

FIRE BRICKS
Harbison-Walker Refractories Co., of Canada, Montreal, Que.

FIRE EXTINGUISHERS
Strong, Kennard & Nutt Co., Cleveland, O.

FIXTURES
Brown Engineering Corp., Toronto, Ont.
Crescent Machine Co., Ltd., Montreal.
Elliott & Whitehall Mach. & Tool Co., Galt, Ont.
Illinois Tool Works, Chicago, Ill.
Marten Machine Co., Hamilton, Ontario.
Toronto Tool Co., Toronto, Ont.

FLEXIBLE SHAFT COILING MACHINERY
Sleeper & Hartley, Inc., Worcester, Mass.

FLAT SPRINGS
The Dunbar Brothers Co., Bristol, Conn.

FLANGING CLAMPS
Wickes Bros., Saginaw, Mich.

FORGES, HAND PORTABLE
Aikenhead Hardware Co., Toronto, Ont.
Can. Blower & Forge Co., Kitchener.
A. B. Jardine & Co., Ltd., Hespeler, Ont.
Rice Lewis & Son, Toronto, Ont.

FORGINGS, STEEL AND IRON
Can. Found. & Forgings, Ltd., Welland.
Nova Scotia Steel & Coal Co., New Glasgow, N.S.

FORGINGS, DROP, AUTOMOBILE AND LOCOMOTIVE FORGING AND WELDING
Victoria Foundry Co., Ottawa.
Dominion Bridge Co., Montreal, Que.
Dom. Forge & Stamp'g Co., Walkerville.
Steel Co. of Canada, Ltd., St. Catharines.
Williams & Co., J. H., Brooklyn, N.Y.

FORGING MACHINERY
John Bertram & Sons Co., Dundas, Ont.
Bliss, E. W., Co., Brooklyn, N.Y.
Brown, Boggs Co., Ltd., Hamilton, Ont.
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Machy. Co., Toronto, Ont.
National Machy. Co., Tiffin, Ohio.
Williams & Wilson, Ltd., Montreal, Que.

FORGINGS, SPECIAL
Armstrong-Whitworth of Can., Montreal.
Can. Found. & Forgings Ltd., Welland.
Williams & Co., J. H., Brooklyn, N.Y.

FORMING
H. Hope & Sons of Can., Ltd., Peterboro

FOUNTAINS, DRINKING
Puro Sanitary Drinking Fountain Co., Haydenville, Mass.

FRICTION LEATHERS
Graton & Knight Mfg. Co., Montreal.

FRICTION SURFACE BELTING
Can. Consolidated Rubber Co., Montreal.

FUEL OIL SYSTEMS
Bowser & Co., S. F., Inc., Fort Wayne.
Gilbert & Barker Mfg. Co., Springfield.

FURNACES, ANNEALING, CASE HARDENING AND TEMPERING
Bellevue Furnace Co., Detroit, Mich.
Chicago Flexible Shaft Co., Chicago, Ill.
Gilbert & Barker Mfg. Co., Springfield.
Mechanical Eng'r'g Co., Three Rivers, Q.
Standard Fuel Engr. Co., Detroit, Mich.
Williams & Wilson, Ltd., Montreal, Que.

FURNACES, BLAST
Bellevue Industrial Furnace Co., Detroit.
Toronto Iron Works, Ltd., Toronto.

FURNACES, FORGING
Gilbert & Barker Mfg. Co., Springfield.
Standard Fuel Engr. Co., Detroit, Mich.

FURNACES, HIGH SPEED STEEL,
Standard Fuel Engr. Co., Detroit, Mich.

FURNACES, LEAD AND SALT
Standard Fuel Engr. Co., Detroit, Mich.

FURNACES, RIVETING
Standard Fuel Engr. Co., Detroit, Mich.

FUSE BOXES, STEEL
Dom. Forge & Stamp. Co., Walkerville.

GANG PLANER TOOLS
Armstrong Bros. Tool Co., Chicago.

GASKETS, LEATHER, ETC.
Graton & Knight Mfg. Co., Montreal.

GASOLINE METERS
Bowser & Co., S. F., Inc., Fort Wayne.

GASOLINE TANKS
Bowser & Co., S. F., Inc., Fort Wayne.

GASOLINE PUMPS, SELF-MEASURING
Bowser & Co., S. F., Inc., Fort Wayne.

GAUGES
Elliott & Whitehall Mach. & Tool Co., Galt, Ont.

GAUGERS, CALIPERS
Williams & Co., J. H., Brooklyn, N.Y.

GAUGES, MERCURY COLUMN, DRAFT
Taylor Instrument Co., Rochester, N.Y.

GAUGES, HYDRAULIC
Taylor Instrument Co., Rochester, N.Y.

GAUGES, MANUFACTURERS, LIMIT, THREAD
Greenfield Tap & Die Corp., Greenfield.
Wells Bros. of Can., Galt, Ont.

GAUGES, STANDARD
Brown Engineering Corp., Toronto, Ont.
Canadian Fairbanks-Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Garvin Machine Co., New York.
Illinois Tool Works, Chicago, Ill.
C. E. Johanson, Inc., Toronto, Ont.
Morse Twist Drill & Machine Co., New Bedford.
Peck, Stow & Wilcox Co., Southington, Conn.
Pratt & Whitney Co., Hartford, Conn.
Taylor, J. A. M., 318 Stair Bldg., Toronto
Toronto Tool Works, Toronto, Ont.
Wells Brothers Co. of Canada, Galt, Ont.
Worth Engineering Co., Toronto, Ont.

GAUGES, THREAD
Bicknell-Thomas Co., Greenfield, Mass.

GAUGES, VACUUM AND PRESSURE
Bristol Co., Waterbury, Conn.
Taylor Instrument Co., Rochester, N.Y.

GAUGES, SNAP, THREAD AND CYLINDRICAL
C. E. Johanson, Inc., Toronto, Ont.

GEAR BLANKS
Can. Steel Foundries, Ltd., Montreal.
Dom. Found. & Steel, Hamilton, Ont.
Kayser-Ellison & Co., Ltd., Montreal.
Norton, Ralph B., Agent, Montreal.
Wilson & Co., J. C., Belleville, Ont.
Williams & Co., J. H., Brooklyn, N.Y.

GEAR BLANKS, CAST
Katie Foundry, Galt, Ont.

GEAR SHAPERS AND CUTTERS
Fellows Gear & Shaper Co., Springfield, V.

GEAR-CUTTING MACHINERY
Bilton Mach. Tool Co., Bridgeport, Conn.
Fellows Gear & Shaper Co., Springfield, V.
Garlock-Walker Mchy. Co., Toronto, Ont.
D. E. Whiton Machine Co., New London, Conn.
A. R. Williams Machy. Co., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

GEAR-TESTING MACHINE
Gisholt Machine Co., Madison, Wis.

GEAR-TURNING MACHINES, BEVEL
Bridgetord Mach. Tool Wks., Rochester.

GEAR BOXES, REDUCTION
Coventry Chain Co., Coventry, Eng.

GEARS, CHAIN
Morse Chain Co., Ithaca, New York.

GEARS, COMPENSATING
Morse Chain Co., Ithaca, New York.

GEARS, CUT, MORTISE, ANGLE, WORM
Baxter & Co., Ltd., J. R., Montreal.
Can. Link-Belt Co., Toronto, Ont.
Dominion Bridge Co., Montreal, Que.
Dom. Foundries & Steel, Hamilton, Ont.
Gardner, Robt., & Son, Montreal.
Grant Gear Works, Boston, Mass.
Hamilton Gear & Machine Co., Toronto.
Hull Iron & Steel Found., Ltd., Hull, Q.
Illinois Tool Works, Chicago, Ill.
Jones & Glassco, Montreal.
Wm. Kennedy & Sons, Ltd., Owen Sound, Ont.
Philadelphia Gear Works, Philadelphia.
Victoria Foundry Co., Ottawa.
Wilson & Co., J. C., Belleville, Ont.

GEARS, RAWHIDE
Gardner, Robt., & Son, Montreal.
Grant Gear Works, Boston, Mass.
Hamilton Gear & Machine Co., Toronto.
Jones & Glassco, Montreal.
Philadelphia Gear Works, Philadelphia.
A. R. Williams Machy. Co., Toronto.

GENERATORS, GEAR
Fellows Gear & Shaper Co., Springfield, V.

GEARS, SPRING
Morse Chain Co., Ithaca, New York.

GEARS, SILENT CHAIN GENERATORS, STEAM TURBO
Can. General Electric Co., Toronto, Ont.

GENERATORS AND CONVERTORS
Can. General Electric Co., Toronto, Ont.

GENERATORS, MOTOR
A. R. Williams Machry. Co., Toronto.
Williams & Wilson, Ltd., Montreal.
MacGovern & Co., Montreal.

GERMAN SILVER
Brown's Copper & Brass Rolling Mills, New Toronto, Ont.

GLOVES, ASBESTOS, ACID PROOF, WATERPROOF, ETC.
Strong, Kennard & Nutt Co., Cleveland.

GLUE HEATERS
Oliver Machinery Co., Grand Rapids, Mich

GLASSES, SAFETY
Strong, Kennard & Nutt Co., Cleveland.
Willson & Co., Inc., T. A., Reading, Pa.

GOVERNOR, WATER WHEEL
Wilson & Co., J. C., Belleville, Ont.

GRAPHITE
Aikenhead Hardware, Ltd., Toronto.
Rice Lewis & Son, Toronto.

GOGGLES
Consolidated Optical Co., Toronto.
Standard Optical Co., Geneva, N.Y.
Strong, Kennard & Nutt Co., Cleveland.
Willson & Co., Inc., T. A., Reading, Pa.
Welding & Supplies Co., Montreal.

GRAVITY CARRIERS
Can. Link-Belt Co., Toronto, Ont.
Jones & Glassco, Montreal.
Morris Crane & Hoist Co., Ltd., Herbert, Niagara Falls, Ont.

GREASE CUPS, PRESSED STEEL, BRASS
Can. Winkley Co., Ltd., Windsor, Ont.

GREASES (See Lubricants)

GRINDERS, AUTOMATIC KNIFE
W. H. Banfield & Son, Toronto.
Canada Machinery Corp., Galt, Ont.
Foss Mchry. & S'ply Co., G. F., Montreal
Garlock-Walker Machinery Co., Toronto.

GRINDERS, CENTRE COLUMN, PEDESTAL AND BENCH
Wisconsin Electric Co., Inc., Racine, Wis.
Blake & Johnson Co., Waterbury, Conn.
Can. Machinery Corp., Galt, Ont.
Cleveland Pneumatic Tool Co., Toronto.
Ford-Smith Mach. Co., Hamilton, Ont.
Foss Mchy. & S'ply. Co., G. F., Montreal.
Garlock-Walker Machinery Co., Toronto.
Katie Foundry, Galt, Ont.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Machine Co., New Bedford.
Niles-Bement-Pond Co., New York, N.Y.
Perfect Machine Co., Galt, Ont.
United States Elec. Tool Co., Cincinnati.
Williams & Wilson, Limited, Montreal.

GRINDERS, CUTTER
Brown & Sharpe Mfg. Co., Providence, R.I.
Cincinnati Milling Mach. Co., Cincinnati.
Foss Mchy. & S'ply. Co., G. F., Montreal.
Garvin Machine Co., New York
Greenfield Machine Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Greenfield, M.
Heald Machine Co., Worcester, Mass.

ROOF COOLERS
Electric Sprays & Metals Ltd., Welland.

ROLLS, CRUSHING
Can. Link Belt Co., Toronto.

RUBBER MILL DRIVES
Can. Link Belt Co., Toronto.

RUBBER MILL MACHINERY
Bertram Ltd., Dundas, Scotland.

RULES
Brown & Sharpe Mfg. Co., Providence.
Jones & Greenwood & Co. Ltd., Sheffield.
Rice Lewis & Son, Toronto.
L. S. Starrett Co., Athol, Mass.

RULES, STEEL, STRAIGHT, AND FOLDING
Lufkin Rule Co. of Can., Windsor.

RULES, BOXWOOD, FOLDING
Lufkin Rule Co. of Can., Windsor.

RULES, BOARD AND LONG
Lufkin Rule Co. of Can., Windsor.

SAW MILL CONVEYORS
Can. Link Belt Co., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

SAFETY DEVICES
Sterne, Kennard & Nutt Co., Cleveland.

SAND MILLS
Pease Mfg. Co., Chicago, Ill.

SAND-BLAST EQUIPMENT SAND BLAST SUPPLIES AND ACCESSORIES
Pangborn Corporation, Hagerstown, Md.

SAFETY APPLIANCES
Sterne, Kennard & Nutt Co., Cleveland.

SAFETY APPLIANCE GOGGLES
T. A. Willson Co., Inc., Reading, Pa.

SAND BLAST ABRASIVES
Pangborn Corporation, Hagerstown, Md.
Pittsburgh Crushed Steel Co., Pittsburgh.

SAND MIXING MACHINERY
Pease Mfg. Co., Chicago, Ill.

SANITARY DRINKING FOUNTAINS
Penn Sanitar Drinking Fountain Co., Hawleyville.

SANDERS, DISC AND SPINDLE
Can. Sander Mfg. Co., Brockville, Ont.

SANDING MACHINES
Canada Machinery Corp., Galt.
Can. Sander Mfg. Co., Brockville, Ont.

SAW MILL MACHINERY
Can. Fairbanks-Morse Co., Montreal.
Canada Machinery Corp., Galt.
Robert Gardner & Son, Montreal.
Curtis Pneumatic Machy Co., St. Louis.
A. R. Williams Machy Co., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

SASH SPRINGS
The Dunbar Brothers Co., Bristol, Conn.

SAWS, CIRCULAR METAL
Wm. Atkins & Co., Ltd., Sheffield, Eng.
Hunter Saw & Machine Co., Pittsburgh.
Marshal, Son & Bunney, Toronto.
Plewes Ltd., Winnipeg, Man.
Simonds Mfg. Co., Fitchburgh, Mass.
Tabor Mfg. Co., Philadelphia, Pa.

SAWS, HACK (See Hack Saws)

SAW SHARPENERS
Greenfield Tap & Die Corp., Greenfield.
Hunter Saw & Machine Co., Pittsburgh.
Wells Bros. of Can., Galt, Ont.

SAWS, SLITTING
J. A. M. Taylor, Stair Bldg., Toronto.

SCALES, MECHANICS'
Lufkin Rule Co. of Can., Windsor.

SCLEROSCOPES
Shore Instrument & Mfg. Co., New York.

SCREENING MACHINERY
Can. Link Belt Co., Toronto.

SCREW EXTRACTORS
Cleveland Twist Drill Co., Cleveland.

SCREW MACHINES, HAND, AUTOMATIC
Brown & Sharpe Mfg. Co., Providence.
Can. Fairbanks-Morse Co., Montreal.
Foster Machine Co., Elkhart, Ind.
Garlock-Walker Machy. Co., Ltd., Toronto.
Garvin Machine Co., New York.
Greenfield Tap & Die Corp., Greenfield.
A. B. Jardine & Co., Hespeler.
National Acme Co., Cleveland, Ohio.
Pratt & Whitney Co., Dundas, Ont.
Wells Bros. of Can., Galt, Ont.
Warner & Swasey Co., Cleveland, O.
A. R. Williams Machy Co., Toronto.
Wood Turret Mach. Co., Brazil, Ind.
Williams & Wilson, Ltd., Montreal, Que.

SCREWS, MACHINE, SET, CAP AND SPECIAL
Galt Machine Screw Co., Galt.
John Morrow Screw & Nut Co., Ingersoll.
National Acme Co., Montreal.
Rice Lewis & Son, Toronto.
Steel Co. of Canada, Ltd., Hamilton.
Wilkinson & Kompass, Hamilton.

SCREW COLLARS
John Morrow Screw & Nut Co., Ingersoll.

SCREW PLATES
Greenfield & Co., Rock Island, Que.
Greenfield Tap & Die Corp., Greenfield.
A. B. Jardine & Co., Hespeler.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Rice Lewis & Son, Toronto.
J. A. M. Taylor, Stair Bldg., Toronto.
Wells Bros. of Can., Galt, Ont.
Wilkinson & Kompass, Hamilton.

SCREW SLOTTERS
Geometric Machine Co., New York.
National Acme Co., Cleveland, O.
Pratt & Whitney Co., Dundas, Ont.

SEPARATORS, MOISTENERS AND OIL FOR COMPRESSED AIR
Pangborn Corporation, Hagerstown, Md.

SELF-OPENING DIES
See Dies.

SEPARATORS, SAND
Pangborn Corporation, Hagerstown, Md.

SET SCREWS, SAFETY
Aikenhead Hardware Co., Toronto.
Bristol Co., Waterbury, Conn.
John Morrow Screw & Nut Co., Ingersoll, Ont.
Wilkinson & Kompass, Hamilton.

SHANKS, STRAIGHT AND TAPER
Jacobs Mfg. Co., Hartford, Conn.

SHAPERS
John Bertram & Sons Co., Dundas.
Can. Fairbanks-Morse Co., Montreal.
Canadian Machinery Corp., Galt.
Geo. F. Foss Mchy. & Sply Co., Montreal.
Robt. Gardner & Son, Montreal.
Garlock Walker Mach'y Co., Toronto.
Hendey Machine Co., Torrington, Conn.
Hamilton Mach. Tool Co., Hamilton.
Williams & Wilson, Ltd., Montreal.

SHAPERS, GEAR
Fellows Gear & Shaper Co., Springfield, V.

SHAFTING
Algoma Steel Corp., Sault Ste. Marie, O.
Can. Fairbanks-Morse Co., Montreal.
Garlock Walker Machy. Co., Ltd., Toronto
Jones & Glassco, Montreal.
Niles-Bement-Pond Co., New York.
Can. Drawn Steel Co., Hamilton.
Pratt & Whitney Co., Dundas.
Rice Lewis & Son, Toronto.
A. R. Williams Machy Co., Toronto.
Wilkinson & Kompass, Hamilton, Ont.
Wilson & Co., J. C., Belleville, Ont.
Williams & Wilson, Ltd., Montreal, Que.

SHARPENING STONES
Norton Co., Worcester, Mass.
Rice, Lewis & Son, Toronto.

SHEARING MACHINES, ANGLE IRON, BAR AND GATE
John Bertram & Sons Co., Dundas.
Bertrams Ltd., Edinburgh, Scotland.
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Machy. Co., Ltd., Toronto
A. B. Jardine & Co., Hespeler, Ont.
Niles-Bement-Pond Co., New York.
Toledo Machine & Tool Co., Toledo, O.

SHEARS, POWER
John Bertram & Sons Co., Dundas.
E. W. Bliss Co., Brooklyn, N.Y.
Brown, Boggs Co, Ltd., Hamilton
Can Blower & Forge Co, Kitchener.
Canada Machinery Corp., Galt, Ont.
Garlock-Walker Machy. Co., Ltd., Toronto
Long & Allstatter, Hamilton, Ohio.
Wickes Bros., Saginaw, Mich.
A. B. Jardine & Co., Hespeler Ont.
National Machy. Co., Tiffin, Ohio.
Niles-Bement-Pond Co., New York.
H. D. Stoll Co., Inc., Buffalo, N.Y.
Toledo Machine & Tool Co., Toledo, O.
Williams & Wilson Ltd., Montreal, Que.

SHEARS, ROTARY
The Quickwork Co., St Mary's, Ohio.

SHEARS, PNEUMATIC
Toledo Machine & Tool Co., Toledo, Ohio.

SHEET METAL ROLLING MACHINES
Peck, Stow & Wilcox Co., Southington.

SHEETS, NICKEL, RESIST. ALLOY
Can. Driver-Harris Co., Ltd., Walkerville.

SHEARS, PLATE CUTTING, SLITTING
Quickwork Co., St. Mary's, Ohio.

SHEARS, SPLITTING
Peck, Stow & Wilcox Co., Southington.

SHEARS, IRREGULAR AND CIRCLE CUTTING
The Quickwork Co., St. Mary's, Ohio.
D. H. Stoll Co., Inc., Buffalo, N.Y.

SHEET METAL MACHINERY
Peck, Stow & Wilcox Co., Southington, O.

SHEARS, SERPENTINE
The Quickwork Co., St. Mary's, Ohio.

SHEARS, SQUARING
Brown, Boggs & Co., Hamilton, Ont.
D. H. Stoll Co., Inc., Buffalo, N.Y.

SHEET METAL WORKING TOOLS
Baird Machine Co., Bridgeport, Conn.
E. W. Bliss Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton
Peck, Stow & Wilcox Co., Southington C.
D. H. Stoll Co., Inc., Buffalo, N.Y.
Williams & Wilson, Ltd., Montreal.

SHEETS, CRUCIBLE, CAST
Kayser Ellison & Co., Ltd., Montreal.
Ralph B. Norton, Agent, Montreal.

SHEET METAL WORKING MACHINERY
D. H. Stoll Co., Inc., Buffalo, N.Y.

SHELVING, STEEL
Dennis Wire & Iron Works, London.

SHIPYARD MACHINERY, SHOP FURNITURE
Dennis Wire & Iron Works, London.

SIDE TOOLS
Armstrong Bros. Tool Co., Chicago.
J. H. Williams & Co., Brooklyn, N.Y.

SILENT CHAINS
Can. Link Belt Co., Toronto, Ont.
Jones & Glassco, Montreal.

SLEDGES
Aikenhead Hardware Co., Toronto, Ont.
Rice Lewis & Son, Toronto, Ont.
Whitman & Barnes Mfg. Co., St. Catharines, Ont.
Wilkinson & Kompass Hamilton, Ont.

SLEDGES, CAST IRON
Katie Foundry, Galt, Ont.

SLINGS, CHAINS
Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.

SLOTTERS
Betts Machine Co., Rochester, N.Y.
Garvin Machine Co., New York.
National-Acme Co., Cleveland, Ohio.
Niles Bement-Pond Co., New York.

SMOKESTACKS
MacKinnon Steel Co., Sherbrooke, Que.

SNIPS, TINNERS AND SHEET METAL WORKERS
Kearney & Trecker Co., Milwaukee, Wis.
J. Morrow Screw & Nut Co., Ingersoll, Ont.

SOCKETS
Brown & Sharpe Mfg. Co., Providence.
Cleveland Twist Drill Co., Cleveland.
Keystone Mfg. Co., Buffalo, N.Y.
Modern Tool Co., Erie, Pa.
J. Morrow Screw & Nut Co., Ingersoll, Ont.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Rice Lewis & Son, Toronto, Ont.

SOIL PIPE FITTINGS, CAST IRON
Katie Foundry, Galt, Ont.

SOLDERING IRONS
Aikenhead Hardware Co., Toronto, Ont.
Brown, Boggs & Co., Hamilton, Ont.
Prest-O-Lite Co., Inc., Toronto, Ont.
Rice Lewis & Son, Toronto, Ont.

SOLDER
Aikenhead Hardware Co., Toronto, Ont.
Canada Metal Co., Ltd., Toronto, Ont.
Rice Lewis & Son, Toronto, Ont.
Tallman Brass & Metal Co., Hamilton.

SPEED REDUCING GEARS
Can. Link-Belt Co., Toronto, Ont.
Jones & Glassco, Montreal.

SLICING CLAMPS
Peck, Stow & Wilcox Co., Southington, Conn.

SPRINGS, MACHINERY
Barnes, Wallace Co., Bristol, Conn.
Can. Steel Foundries, Ltd., Montreal.
Cleveland Wire Spring Co., Cleveland.
Dunbar Bros. Co., Bristol, Conn.
Garlock-Walker Machinery Co., Toronto.
Jas. Steele, Ltd., Guelph, Ont.

SPECIAL MACHINERY
Baird Machine Co., Bridgeport, Conn.
Banfield, W. H., & Sons, Toronto.
Bertram, John, & Sons Co., Dundas.
Bliss, E. W. Co., Brooklyn, N.Y.
Brown, Boggs & Co., Hamilton, Canada.
Brown Engineering Corp., Toronto, Ont.
Ford-Smith Machine Co., Hamilton, Ont.
Garlock-Walker Machinery Co., Toronto.
Elliott & Whitehall Mach. & Tool Co., Galt, Ont.
Garvin Machine Co., New York.
Godley & Edlund, Inc., Courtland, N.Y.
John H. Hall & Sons, Brantford.
A. B. Jardine & Co., Hespeler, Ont.
Katie Foundry, Galt, Ont.
National-Acme Co., Cleveland, Ohio.
Marten Machine Co., Hamilton, Ont.
Sleeper & Hartley, Inc., Worcester, Mass.
Stoll Co., D. H., Buffalo, N.Y.
Victoria Foundry Co., Ottawa Ont.
Wilson & Co., J. C. Belleville, Ont.
William R. Perrin, Ltd., Toronto
Windsor Mach. & Tool Co., Windsor, Ont.

SPRING COILING AND WINDING MACHINERY
Baird Machine Co., Bridgeport, Conn.
Garvin Machine Co., New York
Sleeper & Hartley, Inc., Worcester, Mass.

SPRING MAKING MACHINERY (AUTOMATIC)
Baird Machine Co., Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

SPRINGS, SPIRAL, TOOL
The Dunbar Bros. Co., Bristol, Conn.

SPROCKETS, COMPENSATING
Morse Chain Co., Ithaca, New York

SPROCKETS, SPRING
Morse Chain Co., Ithaca, New York.

SPROCKETS, CHAIN
Can. Link Belt Co., Toronto, Ont.
Grant Gear Works, Boston, Mass
Jones & Glassco, Montreal.
Morse Chain Co., Ithaca, N.Y.
Philadelphia Gear Works, Philadelphia.
Wilson & Co., J. C., Belleville, Ont.

SPRINGS FOR TOYS AND ELECTRIC DEVICES
The Dunbar Bros. Co., Bristol, Conn.

SPROCKET WHEELS, CAST
Can. Link-Belt Co., Toronto, Ont.
Perrin, Wm. R., Toronto.
Wilson & Co., J. C., Belleville, Ont.

SPROCKET WHEELS, CHILLED THREAD
Katie Foundry, Galt, Ont.

SQUARES
Peck, Stow & Wilcox Co., Southington, Conn.

SAFETY CYLINDERS
Oliver Mach. Co., Grand Rapids, Mich.

SANDERS
Oliver Mach. Co., Grand Rapids, Mich.

SAW BENCHES
Oliver Mach. Co., Grand Rapids, Mich.

SAW GUARDS
Oliver Mach. Co., Grand Rapids, Mich.

SAWS SWING
Oliver Mach. Co., Grand Rapids, Mich.

STAYBOLT TOPS
Greenfield Tap & Die Corp., Greenfield, Mass.
Wells Bros. of Can., Galt, Ont.

STAIRS, IRON
Canada Wire & Iron Goods Co., Hamilton, Ont.

STAMPINGS, SHEET BRASS, COPPER, ALUMINUM AND STEEL
Dom. Forge & Stamping Co., Walkerville
Hope & Sons, Henry, of Canada, Peterboro, Ont.
Homer & Wilson, Hamilton, Ont.

STAMPING MACHINERY
Bliss Co., E. W., Brooklyn, N.Y.
Brown, Boggs, & Co., Hamilton, Can.
Canada Machinery Corp., Galt, Ont.

STAMPS, STEEL ALPHABET, FIGURES
Matthews, Jas. H & Co., Hartford, Conn.
Pritchard-Andrews Co., Ottawa, Can.

SAFETY CYLINDERS
Oliver Mach. Co., Grand Rapids, Mich.

STAPLE MACHINES
Sleeper & Hartley, Inc., Worcester, Mass.

STEAM APPLIANCES
Darling Bros., Ltd., Montreal, Quebec.

STEAM SEPARATORS AND TRAPS
Can. Fairbanks-Morse Co., Montreal.

STEEL BALLS
See Balls Steel.

STEEL, CRUCIBLE TOOL
Atkins & Co., Ltd., Wm. Sheffield, Eng.
Illingworth Steel Co., John, New York.
Kayser Ellison & Co., Ltd., Montreal.
Marshall, Son & Bunney, Toronto.
Norton, Ralph B., Agent, Montreal.
Vulcan Crucible Steel Co., Aliquippa, Pa.

STEEL, CARBON, FERRO-TUNGSTEN
Armstrong, Whitworth of Can., Montreal.
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Boker & Co., Inc., H., Montreal, Que.
Firth & Sons, Thos., Montreal, Que.
Kayser Ellison & Co., Ltd., Montreal.
Marshall, Son & Bunney, Toronto.
Norton, Ralph B., Agent Montreal.
Latrobe Electric Steel Co., Latrobe, Pa
Vanadium-Alloys Steel Co., Pittsburgh.
Vulcan Crucible Steel Co., Aliquippa, Pa.

STEEL CHROME VANADIUM
General Steel Co., Milwaukee, Wis.
Kayser-Ellison & Co., Ltd., Montreal.
Norton, Ralph B., Agent, Montreal.
Atkins & Co., Ltd., Wm. Sheffield, Eng
Marshall, Son & Bunney, Toronto.

STEEL CHROME NICKEL
General Steel Co., Milwaukee, Wis.
Kayser-Ellison & Co., Ltd., Montreal.
Norton, Ralph B., Agent, Montreal.
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Marshall, Son & Bunney, Toronto.

STEEL CASTINGS
Jollette Steel Co., Montreal, Que.
Kennedy & Sons, Wm., Owen Sound.
Electric Steel & Metals Co., Welland.
Nova Scotia Steel & Coal Co., Windsor.
Swedish Crucible Steel Co., Windsor.

STEEL, COLD ROLLED
Atkins & Co., Ltd., Wm., Sheffield, Eng.
Can. Drawn Steel Co., Hamilton, Ont.
Kayser-Ellison & Co., Ltd., Montreal.

Marshall, Son & Bunney, Toronto
Norton, Ralph B., Agent, Montreal.
Rice Lewis & Son, Toronto, Ont.
Swedish Steel & Importing Co. Ltd., Montreal.
Union Drawn Steel Co., Hamilton, Ont.

STEEL, NICKEL

Atkins & Co., Ltd., Wm., Sheffield, Eng.
Peel & Sons, Phos., Montreal, Que.
Wilson & Co., J. C., Ltd., Montreal.
Marshall, Son & Bunney, Toronto.
Norton, Ralph B., Agent, Montreal.
Vulcan Crucible Steel Co., Aliquippa, Pa.

STEEL, HIGH SPEED

Armstrong Whitworth of Can., Montreal.
Wm. Atkins & Co., Sheffield, Eng.
Baker & Co., Inc., H., Montreal, Que.
Can. Fairbanks Morse Co., Montreal.
Wm. A. Drury Co., Ltd., Montreal.
Peel & Sons, Phos., Montreal, Que.
Hawkridge Bros. Co., Boston, Mass.
Kingsford Steel Co., J., New York.
Latrobe Electric Steel Co., Latrobe, Pa.
Marshall, Son & Bunney, Toronto, Ont.
Peebles, Ltd., Winnipeg, Man.
Pilot Steel & Tool Co., Montreal, Que.
Rice Lewis & Son, Toronto, Ont.
Swedish Steel & Importing Co., Ltd., Montreal.
Vanadium-Alloys Steel Co., Pittsburgh.
Vulcan Crucible Steel Co., Aliquippa, Pa., represented in Canada by Norton, Ralph B., Agent, Montreal.

STEEL, GRIT

Pittsburgh Crushed Steel Co., Pittsburgh.

STEEL, CHROME, MANGANESE

Joliette Steel Co., Montreal, Que.

STEEL, OPEN HEARTH

Illingworth Steel Co., John, New York.

STEEL, CRUSHED

Pittsburgh Crushed Steel Co., Pittsburgh.

STEEL, ROCK DRILL

Armstrong, Whitworth of Canada, Montreal, Que.
Kayser Ellison & Co., Ltd., Montreal.
Norton, Ralph B., Agent, Montreal.

STEEL, STRUCTURAL

Algoma Steel Corp., Sault Ste. Marie.

STEEL, TOOL

Armstrong, Whitworth of Can., Montreal.
Atkins & Co., Wm., Sheffield, Eng.
Baker & Co., Inc., H., Montreal, Que.
Can. Fairbanks-Morse Co., Montreal.
General Steel Co., Milwaukee, Wis.
Drury Co., H. A., Montreal, Que.
Firth & Sons, Thos., Montreal, Que.
Hawkridge Bros. Co., Boston, Mass.
Kayser Ellison & Co., Ltd., Montreal.
Marshall, Son & Bunney, Toronto, Ont.
Norton, Ralph B., Agent, Montreal.
Latrobe Electric Steel Co., Latrobe, Pa.
Pilot Steel & Tool Co., Montreal, Que.
Rice Lewis & Son Toronto, Ont.
Vanadium-Alloys Steel Co., Pittsburgh.
Vulcan Crucible Steel Co., Aliquippa, Pa.

STEEL, VANADIUM

Wm. Atkins & Co., Ltd., Sheffield, Eng.
Armstrong, Whitworth of Can., Montreal.
Drury, H. A., Co., Montreal, Que.
Kayser Ellison & Co., Ltd., Montreal.
Marshall, Son & Bunney, Toronto.
Norton, Ralph B., Agent, Montreal.
Vanadium Alloys Steel Co., Pittsburgh.
Vulcan Crucible Steel Co., Aliquippa, Pa.
Wells Bros. of Can., Galt, Ont.

STOCK RACKS FOR BARS, PIPING, ETC.

Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.

STOCKS AND DIES

Greenfield Tap & Die Corp., Greenfield, Mass.
Wells Bros., of Can., Galt, Ont.

STOCKS, PIPE

Butterfield & Co., Rock Island, Que.
A. B. Jardine & Co., Ltd., Hespeler, Ont.
Rice Lewis & Son Toronto, Ont.
Wells Bros., Co., of Canada, Galt, Ont.

STRAIGHTENING MACHINERY

Bland Machinery Co., Bridgeport, Conn.
Bertrams, Ltd., Edinburgh, Scotland.

STRAND

Page Steel & Wire Co., Adrian, Mich.

SWITCHBOARDS

Can. General Electric Co., Toronto, Ont.

SWITCHES, RAILWAY

Can. Steel Foundries, Ltd., Montreal.

TABLES, SAND-BLAST

Pangborn Corporation, Hagerstown, Md.

TACK (DOUBLE POINT) MACHINES

Sleeper & Hartley, Inc., Worcester, Mass.

TAPPING MACHINES (PNEUMATIC)

Cleveland Pneumatic Tool Co., Toronto.

TANKS, GASOLINE, KEROSENE AND OIL

S. F. Bowser & Co., Inc., Toronto, Ont.
Dominion Bridge Co., Montreal, Que.
Dom. Forge & Stamping Co., Walkerville.
MacKinnon Steel Co., Sherbrooke, Que.
St. Lawrence Welding Co., Montreal, Que.

TANKS, LUBRICATING, OIL STORAGE

S. F. Bowser & Co., Inc., Fort Wayne.

TANKS, RUBBER CEMENT

S. F. Bowser & Co., Inc., Fort Wayne.

TANKS, STEEL, WATER PRESSURE

S. F. Bowser & Co., Inc., Toronto, Ont.
Dominion Bridge Co., Montreal, Quebec.
MacGovern & Co., Montreal, Que.
MacKinnon Steel Co., Sherbrooke, Que.
St. Lawrence Welding Co., Montreal, Que.
Toronto Iron Works, Ltd, Toronto.

TANK WAGONS

MacKinnon Steel Co., Sherbrooke, Que.
St. Lawrence Welding Co., Montreal.
Toronto Iron Works, Ltd., Toronto.

TANKS

Can. Ingersoll-Rand Co., Ltd., Sherbrooke

TAPES, MEASURING

James Chesterman & Co., Ltd., Sheffield, Eng.
Rice Lewis & Son, Toronto, Ont.

TAPPING MACHINES AND ATTACHMENTS

Bertram, John & Sons Co., Dundas.
Bicknell-Thomas Co., Greenfield, Mass.
Rudel-Belnap Mach. Co., Ltd., Montreal, Canada Machinery Corp., Galt, Ont.
Garvin Machine Co., New York.
The Geometric Tool Co., New Haven.
J. H. Hall & Sons, Brantford, Ont.
A. B. Jardine & Co., Hespeler, Ont.
Landis Machine Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Murchy Machine & Tool Co., Detroit.
Niles-Bement-Pond Co., New York.
Rickert-Shafer Co., Erie, Pa.
National-Acme Co., Cleveland, Ohio.
L. S. Starrett Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Conn.
Williams & Wilson, Limited, Montreal.

TAPES, MEASURING, STEEL AND WOVEN

Lufkin Rule Co. of Can., Windsor, Ont.

TAPES, POCKET

Lufkin Rule Co. of Can., Windsor, Ont.

TAPS, ADJUSTABLE

Boker & Co., Inc., H., Montreal, Que.
Butterfield & Co., Rock Island, Que.
Geometric Tool Co., New Haven.
Modern Tool Co., Erie, Pa.
Murcher Machine & Tool Co., Detroit.
Pilot Steel & Tool Co., Montreal, Que.
Victor Tool Co., Waynesboro, Po.

TAPS, GUN, HAND, BOILER

Greenfield Tap & Die Corp., Greenfield, Mass.
Wells Bros. of Can., Galt, Ont.

TAPS, MACHINE RELIEVED

Greenfield Tap & Die Corp., Greenfield, Mass.
Wells Bros. of Can., Galt, Ont.

TAPS, MACHINE SCREW

Greenfield Tap & Die Corp., Greenfield, Mass.
Wells Bros. of Can., Galt, Ont.

TAPS, PIPE

Atkins & Co., Ltd., Wm., Sheffield, Eng.
Greenfield Tap & Die Corp., Greenfield.
Marshall, Son & Bunney, Toronto.
Wells Bros. of Can., Galt, Ont.

TAPS, STAYBOLT, TAPPER

Greenfield Tap & Die Corp., Greenfield.
Wells Bros. of Canada, Galt, Ont.

TAPS, DIES AND WRENCHES

Butterfield & Co., Rock Island, Que.
Can. Fairbanks Morse Co., Montreal.
Cleveland Twist Drill Co., Cleveland.
Foss Mchy. & Sply. Co., G. F., Montreal.
Geometric Tool Co., New Haven.
Greenfield Tap & Die Corp., Greenfield.
Jardine & Co., A. B., Hespeler, Ont.
Landis Machine Co., Waynesboro, Pa.
Morse Twist Drill & Mchy. Co., New Bedford, Mass.
Murchey Machine & Tool Co., Detroit.
Pratt & Whitney Co., Dundas, Ont.
Rice Lewis & Son, Toronto, Ont.
Starrett Co., L. S., Athol, Mass.
Taylor, J. A. M., 318 Stair Bldg., Toronto.
Wells Bros. of Canada, Galt, Ont.
Williams & Wilson, Ltd., Montreal, Que.

TAP EXTRACTORS

Walton Co., The, Hartford, Conn.

THERMOMETERS, INDUSTRIAL ENGRAVED TEMPERATURE AND PRESSURE

Taylor Instrument Co., Rochester, N.Y.

THERMOMETERS, RECORDING AND INDEX

Bristol Co., Waterbury, Conn., U.S.A.
Taylor Instrument Co., Rochester, N.Y.

TESTING INSTRUMENTS, METALLURGICAL

Shore Instrument & Mfg. Co., New York.

TENOVERS

Oliver Machy. Co., Grand Rapids, Mich.

TESTING LABORATORIES

Toronto Testing Laboratory, Toronto.

THREAD-CUTTING MACHINES

Can. Fairbanks-Morse Co., Montreal.
Curtis & Curtis Co., Bridgeport, Conn.
Garlock-Walker Mach. Co., Ltd., Toronto.
Geometric Tool Co., New Haven.
Jardine & Co., Ltd., A. B., Hespeler.
Landis Machine Co., Waynesboro, Pa.
National Acme Co., Cleveland, Ohio.
National Machy. Co., Tiffin, Ohio.
Pratt & Whitney Co., Dundas, Ont.
Wells Bros. Co. of Canada, Galt, Ont.
Williams & Wilson, Ltd., Montreal, Que.

THREADING TOOLS

Greenfield Tap & Die Corp., Greenfield.
Landis Machine Co., Waynesboro, Pa.
Pratt & Whitney Co., Dundas, Ont.
Wells Bros. of Canada, Galt, Ont.
Williams & Co., J. H., Brooklyn, N.Y.

THREADING MACHINES FOR BOLTS, NUTS AND PIPES

Greenfield Tap & Die Corp., Greenfield.
Wells Bros. Co. of Canada, Galt., Ont.
Williams & Wilson, Ltd., Montreal, Que.

THREAD MILLING MACHINES

Taft-Pierce Mfg. Co., New York, N.Y.
Gray Ball Bearing Co., Ltd., Toronto.
Smalley-General Co., Bay City, Mich.

THUMB SCREWS AND NUTS

See Screws.

TINSMITHS' TOOLS

Brown, Boggs & Co., Hamilton, Can.
Williams & Wilson, Ltd., Montreal, Que.

TIRE BENDERS

Jardine & Co., Ltd., A. B., Hespeler.

TIRE SETTING MACHINES, HYDRAULIC

Perrin, Ltd., William R., Toronto.
West Tire Setter Co., Rochester, N.Y.

TOOL CASES

Rice Lewis & Son, Toronto, Ont.

TOOL HOLDERS

Aikenhead Hardware Co., Toronto, Ont.
Cleveland Twist Drill Co., Cleveland.
Armstrong Bros. Tool Co., Chicago.
Gisholt Machine Co., Madison, Wis.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Dundas, Ont.
Rice Lewis & Son, Toronto, Ont.
Williams & Co., J. H., Brooklyn, N.Y.

TOOL POSTS, LATHE

Armstrong Bros. Tool Co., Chicago.
Williams & Co., J. H., Brooklyn, N.Y.

TOOL ROOM PARTITIONS

Canada Wire & Iron Goods Co., Hamilton.

TOOLS, BENDING

Peck, Stow & Wilcox Co., Southington.

TOOLS, BLACKSMITHS'

A. B. Jardine & Co., Ltd., Hespeler, Ont.
Rice Lewis & Son Toronto, Ont.

TOOLS, ADJUSTABLE BORING

Kelly Reamer Co., Cleveland, O.
Williams & Wilson, Ltd., Montreal, Que.

TOOLS, ELECTRIC

Independent Pneumatic Tool Co., Chicago.
Williams Machy. Co., A. R., Toronto.
Ford-Smith Machine Co., Hamilton, Ont.
U. S. Electrical Tool Co., Cincinnati, O.

TOOLS, FORMING

Davidson Tool Mfg. Co., New York, N.Y.

TOOLS, LATHE, PLANER, SLOTTER

Armstrong Bros. Tool Co., Chicago.
Gisholt Machine Co., Madison, Wis.
Williams & Co., J. H., Brooklyn, N.Y.

TOOLS, SCREW MACHINE

Foster Machine Tool Co., Elkhart, Ind.

TORCHES, BLOW

Int. Mach. & Supply Co., Ltd., Montreal.

TORCHES, STEEL

Armstrong, Whitworth of Can., Montreal.
Prest O Lite Co., Inc., Toronto, Ont.
Welding & Supplies Co., Montreal, Que.

TORCHES, GASOLINE, KEROSENE AND ALCOHOL

Turner Brass Works, Sycamore, Ill.

TRACK SYSTEMS

Morris Crane & Hoist Co., Herbert, Niagara Falls, Ont.
Northern Crane Works, Walkerville.

TRANSFORMERS

Can. General Electric Co., Toronto, Ont.
MacGovern & Co., Montreal, Que.

TRANSMISSION CHAIN

Morris Chain Co., Ithaca, New York.

TRANSMISSION MACHINERY

American Pulley Co., Philadelphia, Pa.
Can. Link-Belt Co., Toronto, Ont.
Can. Fairbanks-Morse Co., Montreal.
Can. Drawn Steel Co., Hamilton, Ont.
Coventry Chain Co., Coventry, England.
Hamilton Gear & Machine Co., Toronto.
Jones & Glassco, Montreal.
Kennedy & Sons, Wm., Owen Sound, Ont.
Morse Chain Co., Ithaca, N.Y.
Wilson & Co., J. C., Belleville, Ont.
Williams Machinery Co., A. R., Toronto.
Williams & Wilson, Ltd., Montreal, Que.

TRANSMISSION ROPE

Jones & Glassco, Montreal, Que.
MacKinnon Steel Co., Ltd., Sherbrooke.
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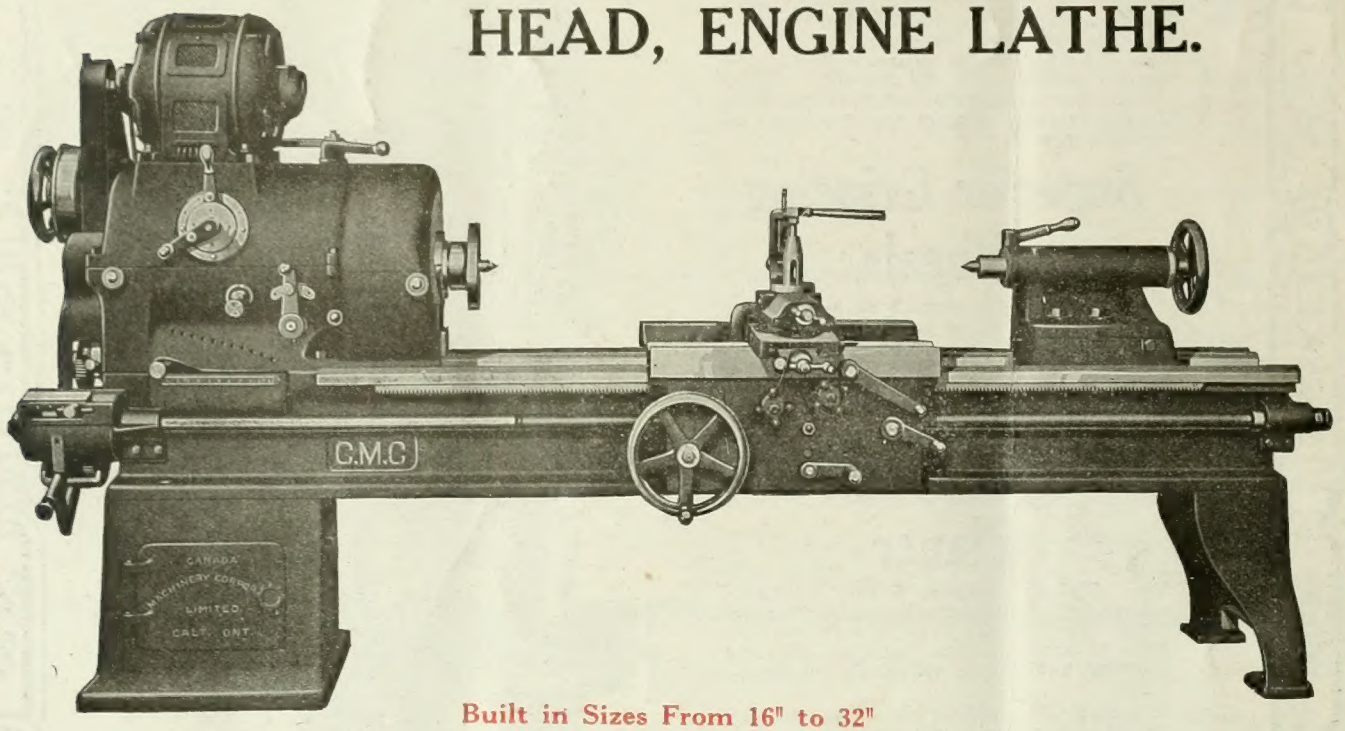

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